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CONFERENCE ON MATURING MAN, GROWTH, AND AGING*

REMARKS

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I express appreciation for being asked to preside at this morning's session. I do not take such assignments lightly, for the seminar which we are about to hear considers questions of fundamental import and wide ramification.

You will hear some facts and implications which can be said to be fundamental in nature. Some of them will have immediate practicability, whereas with others, perhaps, we are not informed sufficiently to put them to immediate use. Fundamental facts do have a habit of fitting into a picture somehow and at some time. I am a poor prophet, so if anyone asks what good are some of the facts of no apparent use today, I'll be content to say "Let's wait and see."

If Abbé, the physicist, and Carl Zeiss, the spectacle maker of Jena, could return to earth today and see what has happened because of their dreams and accomplishments of one hundred years ago, I am sure they would be most happy and readily admit, "How could we foresee what has been learned by the use of good lenses?" I am sure that they would say that practical use was not the only incentive for their burning interest in sand and lime and light and mathematical equations. How much would be subtracted from what we know today if we hadn't had the microscope? I like to think of Abbé and Zeiss as meeting in the evenings in the Ratshaus in old Jena, drinking their beer, eating their belegt Brötchen, and arguing over the solution of their problems.

I have always looked upon science as a grown-up treasure hunt—with the fascinating probability of discovering undreamed-of treasures. Who would have imagined in the 1890's that we human beings had the acids of butterfly-wing pigment in our livers? But when Sir Gowland Hopkins and others found that pteroyl acids were basic constituents of such pigments, the way was opened for exploration of them, and now we know that glutamic acid couples with the pteroyl acids to form the folic acids and their relatives. I need say no more about the importance of these particular compounds.

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I have been told that there is a course in a famous technological institute wherein the students read "science fiction" and then gather around a table to discuss the imaginative stories dreamed up by the authors. Among others, I am told that the question was raised—What problems would a four-legged man face in our world? I mention but one of the many ideas tossed around at such meetings that came to have practical bearing, namely, a balloon to lift up a rocket, and thus spare the fuel of the rocket going through the resistance of the atmosphere.

I would like to see a similar kind of seminar, if that is the name for it, at which any old subject could be thrown into the pot and receive consideration. It would bring out more clearly this point (which is known to many, but often neglected): A wild suggestion leads to the conclusion "Oh, that won't work," and so is dismissed; whereas even if the wildest ones were talked through something might come of them.

The psychiatrists and psychologists have a tiger by the tail at present in the form of lysergic-acid derivatives. The story of how that substance became known is another fascinating tale of "who knows," "what use," and "where and when." Even though the question of the metabolic cycle of the unicorn, when put into a computer in the form of random numbers, finally elicited an answer that there was no rhythm and no such animal, nevertheless, in the midst of the computations several interesting relationships emerged.

And how about such drugs as reserpine and rauwolfia from the snake root of the ancients, and chlorpromazine? Curiosity leads to practical discoveries. Of course, there are dangers in all of this, as well as in all research. Remember the man who drank bourbon and water and got drunk; then he drank rye and water and became drunk; and then gin and water and likewise became drunk. The common denominator of all three was water; therefore he concluded, water makes you drunk!

Well, we are ready for the first paper this morning. Let's try to correlate what is said, each of us in our own way, and when we come to discussion let us not hesitate to prospect and speculate, for in these discussions there may be gold.

So the first paper will be presented by Dr. Clive McCay of Cornell University, "Nutritional Experiments on Longevity"—Dr. McCay:

NUTRITIONAL EXPERIMENTS ON LONGEVITY*

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The purpose of this summary is to present some conclusions after thirty years of attempts to learn about the interrelationships between diet and the changes that occur with age. Progress has been painfully slow. Such research requires both an outlook and techniques that are little comprehended today by either scientists or laymen.

THE ROLE OF ANIMAL CARE AND PROPER ORGANIZATION OF SPECIALISTS IN THE STUDY OF CHRONIC DISEASE AND AGING

Most scientific advances in the fields of biology and medicine have been made by a series of observations upon animals, with each study consuming only a few weeks or a few months of time. In surgical research one may remove the gall bladder or a kidney from an animal, watch it for a few weeks or months, and then undertake another study. During such brief periods the animal body is able to withstand tremendous insults both internally and externally.

The animal may have several diseases of bacterial origin and be something of a museum for the parasitologist. It may be fed a miserable diet but its body reserves protect it from death. It may live in dark, humid quarters but survive. It may even be poorly treated by the caretaker and live in filth. For a few months a dog may survive under such conditions. But if one extended the study to cover a period of years the animal would perish. One would not know which of many variables produced premature death.

In many fields, such as toxicology, the temptation is eternal to test high concentrations of a given chemical for brief periods in order to avoid the expense and tediousness of long-term studies with low levels of ingestion. At the end, however, the results are usually applied to human beings ingesting low levels of chemicals for long periods of time. Examples of such testing in recent years can be drawn in large numbers from studies upon fluorides in water supplies, from studies of the effects of spray residues upon plant foods and from tests of cancer-producing chemicals used in foodstuffs. Thus, much of all the testing of fluorides for use in water supplies has been performed upon rats fed high concentrations of fluoride, such as 50 parts per million, for periods of one to two hundred days. From the results of such testing it is then concluded that it is safe to use 1 part per million of some fluoride such as silicofluoride in the water supply of some large city such as Washington, D.C.

In order to make real progress in the study of chronic diseases in man, such as

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arthritis, cardiovascular disease and cancer, it seems essential that scientists run life-time studies with animals kept under such rigid control that the interpretation of results will not be clouded by extraneous variables that have been neglected. Such long-term studies must first pay attention to the genetics or strains of the test animals. After this, the living quarters and the general care must be of such quality that the animals will not perish from unfavorable conditions in this respect. Hence we must have living quarters and caretakers that are adequate for long-continued studies. Finally we must pay careful attention to the quality of the diets.

Substantial advances have been made in the construction of animal quarters in recent years, especially by the large drug companies that have often set a new standard for research institutes and universities. Such quarters are not luxuries, since they insure control of environmental facts such as humidity, and they make it possible for those who work with the animals to take pride and pleasure in their labors. Who among workers could be expected to provide proper care under the old-time conditions of filth, darkness and humidity found in the animal quarters of ancient laboratories? Since those who plan long-term studies can never have continuous intimate contact with animals during the periods of several years that it takes to complete an experiment, it is important that caretakers be first-class animal husbandrymen. Such caretakers must have both experience and natural abilities. Some people may have the former but lack the latter.

Among students of agriculture we see those who are natural observers of animals and those who are not. Some years ago I had a student living with us on our farm who was a senior in animal husbandry. He cared for my dogs, sheep and other livestock but never seemed to detect a sick animal unless it was near death. At that time I had a chance to apply a test to this student, since we had a male calf ready to be castrated. The outpatient division of our veterinary college had promised to carry out the operation but had not told me the date. One evening as I looked at the calf I realized the operation had been performed, because the animal behaved very differently when I approached it in the evening. I said nothing but checked with the veterinarians and found they had operated on the calf that day. The student never noticed any difference and I did not tell him for ten days, to give him plenty time to detect the change. He had observed nothing. Such men can never become good animal husbandrymen and will never be very satisfactory for studies with dogs, rats, mice or other animals involved in researches upon chronic diseases.

The conduct of long-term researches with animals in the field of chronic diseases needs to be in the hands of men with very broad training in many fields of science such as nutrition, biochemistry, genetics, pathology, psychology, bacteriology, parasitology, histology, physics, physiology, toxicology, pharmacology and even surgery. These are essentially the disciplines of preclinical medicine. It seems to me of little consequence if a person's name ends with an M.D. or with a Ph.D. degree if he acquires some background in these areas.

Even with such backgrounds, workers must have their own specialized train-

ing. Therefore if we are to make rapid progress in the study of chronic diseases we must have groups of specialists working together. Each needs enough background to understand the other specialist's language, but all can make use of a common colony of animals for research.

Since most medical schools are superior to other institutes in areas such as pharmacology, physiology and pathology, whereas agricultural schools are usually better in areas dealing with the care of animals, genetics and nutrition, it seems certain that the most rapid progress can be made in cooperative efforts. Furthermore most agricultural schools have more space and better labor for the care of animals than do medical schools located in congested urban areas. Therefore it would seem logical to handle the animals in long-term studies of chronic diseases in the agricultural colleges but to conduct the final studies, such as those in pathology, in the medical schools.

One may consider two other possibilities in the conduct of long-term studies with animals relative to the diseases of old age. The first is the establishment of combinations of institutes and farms in rural areas, but not far removed from medical research centers. Thus one could conduct long-term experiments with great care, outside metropolitan areas. This would seem to be a workable plan, but it lacks the assets of the large group of highly trained agricultural scientists that are available when such farms are tied closely to agricultural schools.

The second possibility would be the conduct of long-term animal studies through the cooperative efforts of colleges of agriculture and veterinary medicine. This could be done, because the scientists of the modern veterinary college are competently trained today. However it seems quite impossible, as veterinarians are oriented in their thinking primarily toward infectious and parasitic diseases of farm animals that are slaughtered before they attain more than middle age. Some attention in the area of clinical veterinary medicine is given to old pets such as dogs and cats; but these, like riding horses, are regarded as luxuries unworthy of support and attention even in the interests of basic science.

The long-term conduct of research with animals such as dogs or even mice requires space and superb animal husbandry. It is also very expensive, because large numbers of animals must be used. Animals are like men inasmuch as only a given percentage succumb to a given disease such as cancer before some other disease such as bronchiectasis destroys them in old age.

I became very aware of this during the summer of 1957, when I was reviewing data upon the life span of some of the many strains of mice kept at the Jackson Memorial Laboratory at Bar Harbor. Each strain had been bred to be highly susceptible to a given form of tumor but there was almost always a substantial residue of mice of every strain that escaped the tumor and had their lives terminated by some other disease.

The affliction of all animals in an experimental group by a common chronic disease is an exception rather than a rule. One can think of some examples, however. Thus in the case of rabbits afflicted with atherosclerosis from the feeding of cholesterol, every animal in a group may die with the disease because it cannot survive long enough to perish from some other affliction. In the case of

bone tumors produced in rats by feeding radioactive calcium[45], every rat in the group fed the highest concentration may perish with a bone tumor because no animal survives long enough to die from diseased kidneys or bronchiectasis of the lungs. However, if one studies groups of rats forced to grow slowly after being fed the high dosage of calcium[45], or those fed a lower dosage of calcium[45], one finds that all animals are not eradicated by the bone tumors; a residue survive to perish from other diseases.

Consideration of the percentage afflicted and dying of a given chronic disease is very important in this research field, because most human problems are the reflection of long-continued use of specific diets or ingestion of material such as lead, a carcinogenic dye or radioactive strontium, rather than the consumption of high dosages of an injurious substance for a short period. This makes the whole field of research upon the relation of diet to aging far more difficult and more expensive than is the study of infectious diseases.

This lengthy introduction to the problems of the researcher in gerontology has been presented because of its vital importance. The whole area of knowledge of chronic diseases has been retarded because of lack of appreciation of these problems rather than by our lack of tools and techniques for attacking the problems. Available methods of science for the study of chronic diseases are far ahead of our organization for the correct use of experimental animals and for cooperative efforts of specialists.

INFLUENCE OF DIET UPON LONGEVITY

In the remainder of this brief review a series of examples will be cited from our own research that bear upon the problem of the influence of diet upon longevity.

In the first place every researcher must have faith that what he attempts is not impossible. He must realize that such problems as the improvement of health in old age can be solved. If we believe that the diseases of old age that ultimately destroy us are predestined by God and that nothing we do in the conduct of our life can modify these afflictions we must remain completely frustrated as research scientists.

Thirty years ago we became convinced that the diseases of old age in experimental animals such as white rats could be changed by control of the diet. A diet excellent in quality but insufficient in amount permitted extension of the span of life by retarding all the common diseases of old age such as those of the lungs and kidneys, and even the cancers that arise spontaneously. Dietary changes could be introduced in middle-life when the common chronic diseases were well started; yet such factors as reduction in body fat would modify the terminal diseases and extend the length of life.

These studies gave us faith that our life would not be wasted if we devoted it to the study of diet and old age. Results are certain for any well trained investigator, if he is willing to invest hard study, originality and long-continued effort in research concerning the relationship between diet and old age and its afflictions.

Perhaps it is well to state concisely what we know before proceeding with

examples from research. We are certain that what an experimental animal eats has a profound influence upon its length of life, upon the diseases of old age and upon its health during much of the span of life. We know that the most effective control of the diseases of later life must begin early, but that the latter half of life may be influenced even when dietary changes are introduced in middle life.

As an example we may consider some of the common tumors that afflict animals just as they do man. Such tumors seem related to the rate of aging, since they afflict rats or mice in the course of the two years in which they grow old just as they do man in the course of his seventy years of life. Thus the events that produce tumors in rodents move about thirty-five times as fast as they do in man. This is true of many of the changes of aging.

Fifty years ago Moreschi and Ehrlich found that it was impossible to transplant a tumor in a partly starved mouse. Since that date, we and many others have found that rats retarded in growth by the underfeeding of an excellent diet are not subject to common tumors such as those of the mammary gland. This story can now be brought up to date in regard to bone tumors.

Radioactive elements

About ten years ago Leroy Barnes and others in our laboratory started producing bone tumors in white rats by feeding them radiaoactive calcium for a period of two weeks shortly after weaning. All rats fed a given concentration of this calcium[45] would die of bone tumors after completing one third to one half of the normal span of life. During the past few years Dr. C. E. Brown has been studying these neoplasms. Rats fed a lower dosage of calcium[45], seldom lived long enough to develop a bone tumor. In dogs fed the high dosage of calcium[45], fractures occurred, which healed spontaneously. These beagles are now nearly 5 years old, but in none of them did a bone tumor develop. Does this mean that dogs are much less susceptible to radioactive calcium, or does it mean that it takes years and a much greater proportion of the normal life-span for the tumor to develop in the dog than in the rat? Is man more like the dog or more like the rat in his susceptibility to bone tumors following absorption of such materials as radioactive calcium and strontium?

These answers can be obtained only by years of tedious, difficult research.

One may ask if bone tumors may be affected by retarded growth of rats, in the same manner as some of the soft tumors. An answer is beginning to emerge as a result of our studies of the past few years. It looks as if retardation of the growth of rats lowers the susceptibility to bone tumors, and that these growths also tend to appear upon the jaw of the rat rather than upon the epiphyses or growing areas of the long bones. Thus retarded growth from partial starvation seems to modify the development of bone tumors.

Finally we attempted to determine if the feeding of calcium[45] to middle-aged rats would produce tumors. This is of some interest to most adults who are now being subjected to some degree of fall-out. The study is still in progress, but it appears that in rats given radioactive calcium in middle life, tumors develop upon the jaws and not upon the long bones or the vertebrae. Eventually, these

tumors will be sent to Dr. Brown to determine if they resemble those formerly seen in people who painted watchdials with radioactive materials.

These studies illustrate the nature of long-term studies that must be made if we are to anticipate the effects of radioactive materials upon man and animals. Such studies must involve prolonged tests upon large numbers of animals fed very low concentrations of radioactive elements.

Prolonged milk-alkali diets

We may now leave the subject of radioactive elements and consider another problem involving diet and old age. This concerns the effects of long-continued diets of milk supplemented with sodium bicarbonate, as traditionally used in the treatment of gastric ulcers. They are often called "Sippy diets." From time to time it has been claimed that such diets produce calcification of the kidneys, and sometimes stones in the bladder. The evidence from statistics based on human subjects has never been convincing.

However, this problem of the effect of milk diets is amenable to study with common white rats, because they are fond of milk and will consume bicarbonate along with it. During the past twenty-five years many observations have been made upon calcification of the soft tissues of animals after the life-time feeding of various diets. One observation has been fairly consistent, namely, that the kidneys of females are more subject to calcification than are those of males.

About three years ago one of our students from Thailand, P. I. Sambhavahool, decided that he would use rats in the long-term study of the effect of Sippy diets upon the formation of calculi in the bladder and upon calcification in the kidneys. He included Syrian hamsters as well as albino rats. His research has now been completed and the work is being extended by a new graduate student, Beth Empey.

The findings of this study were that the prolonged feeding of milk produces marked calcification in the kidneys of female rats, and calculi in the bladders of male rats. Sodium bicarbonate seems to accentuate these effects. No such results were observed in the case of the hamsters.

This study indicates the importance of the choice of species of animal in attacking problems of man concerning the relationship between diet and the diseases of old age. Rats seem to have kidneys that deteriorate much more in old age than do those of the hamster. Likewise rats seem more subject to the formation of stones in the bladder. This study does indicate the usefulness of small animals such as the white rat in a fairly rapid attack upon these basic problems.

Validity of data

It may be worthwhile to consider briefly how one extends such research. In the first place one may ask the reason for the sex differences. An approach to this problem involves castration of some male rats to determine if this makes them react like female rats to the Sippy diets. Since milk is known to be rather low in magnesium, and since magnesium has long been implicated in the calcifi-

cation of the kidneys of guinea pigs, one may ask if supplementation of the milk diets with magnesium will reduce renal calcification. Since the composition of milk is known, it is not difficult to make up milk in the laboratory and feed it. One can then substitute one of its fractions, such as carbohydrate, by some other carbohydrate and thus determine if the lactose of milk may be the agent promoting calcification of kidneys. This is the way one projects testing into the future and illustrates methods of attack upon such problems.

This experiment can be used to illustrate another type of research that has been carried on from time to time during the past fifty years but that fails to advance the knowledge of gerontology. Some histologist obtains the kidneys from a species such as the mouse. The only fact he possesses is the approximate ages of the mice at the time of death. He proceeds to make a very careful study of the histology and pathology of these kidneys. Ultimately he publishes a paper relating the age of the mice to the state of the kidneys. He neglects entirely the genetics of the mice. Mice vary widely in their susceptibility to chronic diseases and the length of their span of life, relative to inheritance. Both diet and sex, at least in the case of rats, have a profound influence upon susceptibility to diseases of the kidneys in old age. These factors of diet and sex were also forgotten in the studies on mice. Therefore, were the conclusions valid about the state of the kidneys of these mice in relation to age? The most one can conclude is that in mice under certain conditions, some type of renal deterioration may develop.

Need for groups of cooperating specialists

These difficulties in obtaining carefully controlled groups of animals, illustrates the need for studies by cooperating groups of specialists.

The use of mice in the study of problems of aging affords two other examples of the need for cooperating specialists. Thirty-two years ago, while I was still a student at Yale, I chanced to visit the mouse laboratory of Maude Slye in Chicago. Many of you may not recall that she pioneered in relating genetics to cancer. At that time most of the people I knew doubted the relationship. I was most impressed by the care with which the food for these mice was sterilized by heat.

During the past two decades many mouse colonies have suffered severely from epidemics of Salmonella. This organism is commonly introduced into the food of mice by one ingredient, namely, the dried meat scrap. A few years ago, those in charge of the production of mice in our State Health Laboratories in Albany wrote us suggesting that we help in developing diets free from Salmonella. Such diets were developed; they were free from meat scrap but adequate for reproduction in mouse colonies. This illustrates the part the bacteriologist must play in the protection of mice used in long-term studies.

These studies also illustrate the need for cooperation from those familiar with agriculture. For some years there has been growing evidence that some plant materials, such as alfalfa and one of the "underground" clovers from Australia, contain estrogens. The Australians first became aware of these plant estrogens because, in some of the areas where sheep fed upon pastures of this

clover, reproduction declined to 10 per cent and the farmers were out of business.

One may ask how this is related to the use of mice in the study of aging. Many commercial diets for mice contain small amounts of plant materials such as alfalfa-leaf meal. These small amounts do not seem to interfere with reproduction in rats, mice, dogs and hamsters.

However about three years ago, there was substantial failure in reproduction in some mouse colonies. This failure coincided with the widespread use of stilbestrol in the feeding of beef cattle. Meat scrap from these cattle was used to the extent of 20 to 30 per cent in the diets of mice, dogs and rats. At present it looks as if this increase of estrogens in the mouse diet were the cause of the trouble. Whether or not there have been such effects on reproduction in rats and dogs is not known. Fortunately, in our laboratory we had already eliminated meat scrap from our mouse diets because of Salmonella and now we have a second reason for not using it.

This discussion of the problem is introduced to show the importance of diverse specialists in the handling of animals maintained for a long time. The bacteriologist was needed to determine the source of the Salmonella. Only those familiar with agriculture would be aware at this time of estrogens in plants such as alfalfa and Australian clover. Today we know nothing about the relation of these plant estrogens to the production of tumors or other diseases in mice.

Another example of the important part the bacteriologist or virologist may play in the study of aging can be drawn from our own difficulties of the past summer.

Some months were occupied in planning a rather intricate study, using hamsters, to determine interrelationships between diet, osteoarthritis and the deterioration of bones and teeth in old age. An earlier study had indicated these problems were interrelated.

The plan called for the use of 600 young hamsters fed 48 variables in beverages and diet. It was planned to start this new experiment with 100 hamsters per month. However as the hamsters arrived from the producer, quite a number were lost after each shipment due to what is known as "wet tail" disease. We seldom see this disease in hamsters produced in our own laboratory. Some of these new hamsters died within the first few weeks after arrival, whereas the rest seemed to become immune and live normal lives. However this upset the plan and numbers in the study, because the dead animals had to be replaced.

A visit was made to the hamstery, but it was found that sanitation and handling of these animals in production seemed beyond criticism. Thus far we have found no method for controlling this disease. It is possible that our own animals carry it and have become immune, but can infect hamsters from the outside.

A second example of the importance of another specialist—the parasitologist—can also be drawn from our experiences of the past summer.

As many know, the Army is in charge of long-term research upon animals and men to determine if the sterilization of foods by beta and gamma radiation is free from danger. Such studies involve prolonged testing upon several different

species of animals, including dogs. Since our laboratory owns a kennel of registered dogs, we had agreed to supply beagles to a number of university laboratories undertaking contracts for this Army testing.

Although our veterinarians carefully try to immunize all of our puppies against distemper, they failed for the first time in two decades, and we had about 15 cases of distemper of which 6 were so severe that the dogs had to be killed for study. The distemper was not a very serious matter in itself, but with it came the dreaded dog nematode, Strongyloides. This parasite seems to thrive upon dogs sick with distemper. It is a common parasite among people in the tropics and is not unknown in our area.

There seems to be no known treatment that is effective for either dogs or men. No one seems certain whether the parasite is the same in man and dog. No one seems to know if it is transmissible from one to the other. Veterinarians seem to have great fear of this parasite. Human clinicians seem to pay little attention to it.

This pest and a half dozen others that afflict dogs can cause serious trouble in long-term studies. Although Strongyloides is readily identified by concentration with zinc-sulfate solution, it is probably not observed by most veterinarians who concentrate fecal parasites with sugar or salt solutions. Hence we have no knowledge of the extent to which it may complicate research in which dogs are used. There is great need for study of the control of such parasites, so that the treatment can be used by those involved in research. Fortunately Strongyloides does not seem to bother adult dogs, even though some may carry it. It has not interfered with our long-term studies of such factors as the effect of radioactive calcium upon dogs.

In the future, two other specialists may also play important roles in the study of old age, namely the dentist and the surgeon. For twenty years we have been aware that the condition of the teeth may influence the ability of an experimental animal to eat, and thus modify the nutrition and life span. However our strain of rats as well as our dogs have teeth that are very resistant to decay. In only 1 case did we have to terminate a long-term study because of the condition of the teeth. In this instance we were comparing the effects of various common beverages such as milk, soft drinks and coffee. We had to stop giving the rats the cola beverage when about a third of the way through the study, because the molars were eroded down to the gum line. There was no evidence against coffee, but results indicated that rats given milk for the whole of life ended with the best teeth and bones. The females had calcification of the kidneys but this did not affect the total span of life. The kidney is an organ with remarkable factors of safety.

Others also have had nutrition studies invalidated by the condition of the teeth of the animals. Some years ago animal nutritionists feeding steers with rock phosphate to provide calcium and phosphorus had to stop the experiment because the fluoride of the rock had produced teeth that disintegrated. Hence the steers could no longer chew hay.

Since the hamster and the cotton rat are much more subject to deterioration of the teeth than are most strains of rats, the condition of the teeth may prove a limiting factor in studies using these species.

During the past few years we have come to appreciate the important role that the surgeon and the anesthetist may play in the study of aging. For some years we have made slow progress in using the method of parabiosis. In this old and conventional operation of making "Siamese twins" from litter-mate rats, neither the surgery nor the anesthesia is very difficult. However both become very difficult as one attempts the combination of animals of different ages. When the size of the 2 animals is about the same, the problems can be overcome; but the procedure is usually a failure when dealing with animals of different size and different age.

This is only one small example of the vast area ultimately to be opened, in which we can relate nutrition, anesthesia and surgery in old age.

Cooperation. Before leaving this subject of the attack upon the problems of diet and aging, the most difficult problem of all should be given a few lines. It is not the provision and financing of laboratories for work; it is not the superb handling of animals that permits them to survive in old age; it is not the assembling of cooperating groups of specialists; it is the difficulty in getting groups of "prima donnas" to labor together without dissipating their energies in fighting each other. Perhaps we need to give just as much attention to the training of personalities as we do to the schooling in disciplines. The problem is the maintenance of the greatest possible freedom of the individual so that he can use his abilities in making discoveries and still cooperate with a group so that this group is effective.

Applied nutrition

In this discussion little attention has been given to the numerous fields of applied nutrition, such as the development of better basic foods, *e.g.*, bread. This can be summed up in a few words. Much more is known about the best foods for people of all ages than is put into practice. This failure to make use of what is known is due primarily to ignorance and the indifference of the average person to his own health. Most people dissipate their health resources and turn to the physician for a panacea pill after the damage is done.

There are small groups scattered throughout the world that devote much attention to the production, preparation and eating of the best possible foods. A few of these people come from the educated and intelligent. Some are found as fundamentalist religious groups such as the Seventh Day Adventists and Jehovah's Witnesses. Far too few are found among highly trained biochemists and nutrition scientists. Many of the last cast doubts upon their own science. Watch them at their meals and wonder.

Some industries regularly oppose the production of better foods. Thus the better breads are commonly opposed because it is more difficult to operate an automatic bakery producing the best breads than the ordinary ones. The macaroni makers oppose improvement in the making of their products by setting up

"standards of indentity" that provide a mediocre ceiling upon quality. By means of government lawyers and federal controls the improvement of some food products is thus checked.

It takes hard study, great watchfulness and much self discipline for the housewife to provide her family with the best foods. "Best" means nutritive value and may mean taste. It does not mean "best" in the empty sense of the customary blatant advertising.

Most nutritionists must be ardent pessimists because of the few people or even institutions for the aged that take much interest in good nutrition. However the nutritionist need not feel too downcast. He reaps from the public, reactions similar to those visited upon his colleagues who are interested in preventive medicine or the maintenance of health at all ages.

We have tried to present some of the thoughts of one research chemist who has now spent more than three decades laboring with diverse specialists in attempting to solve some of the basic and applied problems concerning the relationship between diet and disease in old age.

CELLULAR MECHANISM OF METABOLISM

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The recent spectacular start on Man's conquest of space forcibly emphasizes the virtually unlimited potentialities of the human organism. It also may remind us of how little we know of Man himself. It is a further tribute to Man's ingenuity that he has accomplished so much in the control of disease, knowing so little of the body he occupies. However, just as he is making his first steps toward liberation from this planet, he is also discerning something of the vast, intricate network of chemical reactions which in their totality make up the life process. In our ignorance of the life processes, the process of aging is no exception. Almost from the day we are born, our bodies begin to age—and the process is so orderly and predictable that none of us has any difficulty in estimating roughly a person's age. We recognize this *must* reflect a background of inner chemical and physical changes. Unfortunately, the nature of these changes still escapes us. Before we can understand, much less control, the process of aging, we must learn much more about the basic physiology and biochemistry of cells. It is particularly important to learn something of the mechanisms of control and regulation of the metabolism of foodstuffs. In my opinion, this is the field where rewards seem richest for ultimate understanding of aging, and the control of the metabolic diseases associated therewith.

In carrying out my assigned task at this meeting I have chosen first to give a brief, and necessarily oversimplified description of what we know of these processes; second, to show where in these networks of reactions, disturbances or lack of control might lead to disease; finally, I should like to discuss some of the more hopeful areas of research progress in atherosclerosis, which runs a neck-and-neck race with cancer as the number one challenge to medical science today.

CELLULAR PROCESSES

Figure 1 shows a very rough outline of the transformations and interconversions of the foodstuffs and the cell components. Sugar and fat make up the two principal sources of energy. Each follows certain main pathways and certain side-roads in its metabolism. Glucose follows a main path through pyruvic acid to acetic acid. Branching off from pyruvic acid is lactic acid, a dead end. One of the peculiarities of cancer cells is that this road is wide and hence they accumulate large amounts of lactic acid. During the past eight years we have been trying to learn why cancer cells accumulate lactic acid (2). Perhaps when we do learn why, we may understand what makes a cancer cell. A main road of fat metabolism also leads to acetic acid. This simple substance, familiar to all of us in vinegar, is a key intermediate, a focal point for the metabolism of both of these

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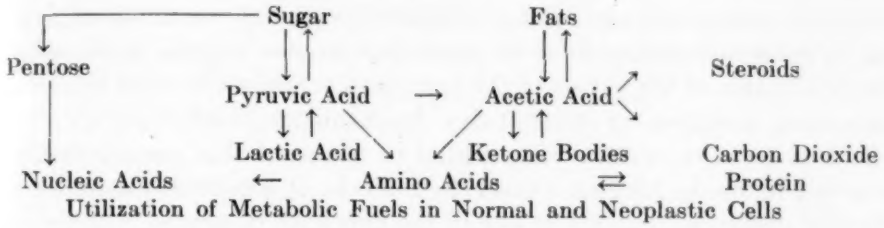

FIG. 1. Transformations and interconversions of foodstuffs and cellular components.

major fuels. Radiating from acetic acid are highways leading to nearly all of the important cell components.

When farmers feed corn to hogs, or when we ourselves indulge too freely in carbohydrate, we become only too well aware that animals are capable of converting carbohydrate to fat. This diagram shows how this occurs, via pyruvic and acetic acids. Another metabolic path of acetic acid leads, by an intricate and yet not completely understood process, to cholesterol, and thence to the bile acids and to the bewildering variety of adrenal and sex hormones. By way of another path, acetic acid is converted to the heme pigments which, like hemoglobin and the cytochromes, play a role in respiration. Other paths lead to many of the 20 amino acids which make up the building blocks of the proteins. A very important and intricate path, the citric-acid cycle, leads to carbon dioxide. Every cell is a miniature power plant for which acetic acid is the fuel. Its conversion to carbon dioxide yields large amounts of energy, just as does the combustion of coal or gas in a boiler. Instead of being coupled directly to a piston or turbine, the energy of combustion in biologic systems is trapped in various phosphate-containing nucleotides. These substances are themselves built up from sugar and fats. These so-called high-energy phosphate compounds constitute the medium of energy exchange in the cell. They are formed during the release of energy by combustion, and are utilized by the multitudinous reactions requiring energy—growth, enzyme synthesis and muscle contraction, to cite a few examples. The same or similar substances, the nucleic acids, are involved in the most intimate processes of cell maintenance, reproduction, and inheritance of characteristics.

Many of the vitamins play the role of co-enzymes in the reactions shown here. For example, nicotinamide and riboflavin are involved in the combustion of glucose and fatty acids; pantothenic acid is involved in the transformations of lipides and sterols, as well as of acetic acid; thiamine is involved in the metabolism of glucose and pyruvic acid; and pyridoxin, folic acid and vitamin B_{12} are involved in the synthesis and destruction of many of the amino acids and some components of the nucleic acids.

LOCALIZATION OF ACTION

One important forward step in cellular exploration is the recognition that the hormones, those mysterious chemical messengers secreted by the endocrine organs, are powerful regulators of metabolic processes. The fact that these

substances affect such age-related functions as growth, metabolism, body build and reproduction makes them of particular interest for the problem of aging. The localization of the action of the hormones is one of the most interesting and challenging problems of present-day biochemistry. Unfortunately, relatively little is known for certain with regard to where in this complicated maze of metabolic paths the hormones exert their effects. It is generally assumed that the action of insulin is localized at one of the gateways of glucose utilization in the cell. The problem of the mechanisms of this action is being pursued actively in our laboratories, and work conducted there suggests this hormone also exerts effects on glucose output by the liver (3).

Other endocrine secretions affect other metabolic loci. The growth hormone of the pituitary gland affects both fat mobilization and protein synthesis; the estrogenic and androgenic hormones are said to play parts in the regulation of protein, fat and carbohydrate metabolism; and the adrenal steroids, with cortisone as the prime example, are presumed to function in the control of protein synthesis as well as in mineral and glucose metabolism. It is becoming increasingly apparent also, that some of the steroid hormones may profoundly influence the synthesis of cholesterol. It has been suggested that thyroxine or related thyroid hormones function in metabolic regulation by controlling the coupling of energy from combustion reactions to the normal energy exchange systems of the cell.

Unfortunately, precise metabolic localization of the action of these hormones has not yet been possible. It seems likely that we shall have to await such precise localization before obtaining a full explanation, in metabolic terms, of the effects of the hormones on the whole animal.

BASIC RESEARCH IN ATHEROSCLEROSIS

I should like to devote the remainder of the time at my disposal to the question of basic research attacks in the field of atherosclerosis. As with other widespread diseases, there is surrounding this process a host of misconceptions. In reviewing the vast literature it is extremely difficult to distinguish fact from conjecture.

Blood cholesterol and lipoproteins

It is generally believed, though by no means proved, that atherosclerosis is primarily a disease of cholesterol metabolism. Without detailing the justification for this view, it can be summarized as follows: first, production of atherosclerosis experimentally by such means as chemical, mechanical or thermal injury has never been successful, whereas the feeding of cholesterol, either with or without auxiliary treatment, produces a closely related, if not identical condition in rabbits, fowl, monkeys, dogs and even rats (4). However, despite many clinical studies, there has not been found any clearcut direct association between the cholesterol content of the blood and the degree of atherosclerosis, either as determined clinically or by postmortem examination of arteries. The results of several recent studies suggest that clinical symptoms of arteriosclerotic heart

TABLE 1

*Comparison of Lipid Composition of Blood Plasma and Arterial Tissues**

	Blood Plasma	Intima	Early Plaques
Free cholesterol	14.1	14.2	16.2
Cholesterol esters	38.3	38.6	38.5
Phospholipids	22.8	20.1	19.0
Neutral fat, etc.	23.3	27.1	26.3

* The values are given as percentages of total lipid.

disease are more likely to develop in persons with a definitely high plasma choesterol level, but the degree of correlation has not been impressive (6, 7).

In cholesterol-induced atherosclerosis, it has been shown by many investigators including ourselves (5) that there is a rise in the concentration of all the blood lipides, not only that of cholesterol. Moreover, all of the blood lipides are deposited in the intimal tissue, not only cholesterol (Table 1). The complex of lipides, as a whole, appears to be involved and thus it is a disease of lipide metabolism, not necessarily of cholesterol metabolism. Perhaps the most persuasive evidence is that cholesterol is found in abundance in atherosclerotic lesions. However, this is a late phenomenon, not discernible in the initial phases of the disease.

It has been evident for many years that the presence, in clear solution, of relatively large amounts of lipides in the blood plasma must be due to some chemical combination between the lipides and other plasma components. The lipides themselves are highly insoluble in aqueous solutions and would not permit the high concentrations observed normally in the plasma. Evidence has accumulated to indicate that these lipides are associated with the α and β globulins, and they have been separated into two classes designated as α and β lipoproteins (8). The first has a relatively low molecular weight (200,000), relatively low lipide content (40 per cent), and consequently high density; the second has a relatively high molecular weight (1,300,000), a relatively high lipide content (77 per cent), and a relatively low density. Essentially all of the plasma lipides are in these two fractions; their lipide composition is shown in Table 2, taken from Surgenor (8).

Recent years have been marked by considerable controversy over the significance of lipoproteins in the causation of atherosclerosis. In 1950 John Gofman and his associates of the Donner Laboratory of the University of California announced a centrifugal flotation procedure for separation of lipoprotein fractions from human plasma. They made the further startling announcement that certain of these fractions were elevated in the blood of persons with clinical symptoms presumptive of atherosclerosis. They stated that a determination of these classes of lipoproteins in the plasma was of prognostic value in indicating the probability of the occurrence of clinical manifestations of this disease. Many of you are aware of the hysteria which followed the wide publicity given to this

TABLE 2

*Lipid Composition of Human Plasma Lipoprotein**

(Values are in per cent of lipoprotein)

Lipid	Lipoprotein	
	Alpha	Beta
Free cholesterol	3.3	8.3
Cholesterol esters	15.0	39.1
Phospholipids	21.0	29.3
Total	*39.3*	*76.7*

* From Surgenor: Symposium on Atherosclerosis (8).

essentially unproven hypothesis. Possession of a high atherogenic index of the plasma lipoproteins was widely regarded as a poor prognostic omen.

Because of the potential extraordinary importance of these reports, action was taken by the Heart Council of the National Institutes of Health, and soon a cooperative study was instituted to evaluate the prognostic significance of the lipoprotein and of the blood cholesterol patterns, using essentially the methods employed by Gofman and his group. The results thus far have been published recently (7). Time will not permit a complete discussion of the technical details, but it can be assumed that the study was conducted under the most competent supervision and arranged to achieve minimal personal bias. Statistical analyses were conducted by a separate group of competent statisticians. The conclusion of the three laboratories was that neither the lipoprotein patterns nor the blood cholesterol levels were of specific predictive value in atherosclerosis. The degree to which these criteria were found wanting may be seen in the following quotation from this report.

"This limitation of the lipid measure may also be illustrated by consideration of a hypothetical population of 1000 'well' men with an incidence of coronary heart disease, in relation to lipid values, similar to those studied here. Among 1000 'well' men of the ages studied there might be expected at most 20 new occurrences of coronary heart disease during two years of observation. By considering the half of the 1000 men with highest lipid levels as under suspicion from the outset, *i.e.*, by setting the cutting point at the median, a correct prediction would have been made (depending on the lipid measure used) for only 10 to 14 of the 20 men who, in this hypothetical population, would have experienced a new event. Six to 10 of the new events, or a third to a half, would have been missed—these are the 'false negatives.' Almost 500 men, or about 50 per cent of the total population, would have been placed under suspicion but would not have experienced any event of clinical importance—these are the 'false positives.' The only way to diminish the number of 'misses' or 'false negatives' would be to set the cutting point at some position below the median, but this would further inflate the number of 'false positives.' It is this imprecision that casts serious doubt on the utility of these lipid measures in case finding or therapy."

Obesity

We might briefly mention some other misconceptions associated with atherosclerosis. For example, it is usually stated that caloric excess, leading to obesity, is a critical factor. According to Ancel Keys (9), this idea " . . . has been more widely proclaimed than objectively studied." In his recent review, he finds that when the problem has been carefully studied, "coronary patients are little if any fatter than healthy controls of the same age and population." Another misconception is that there is a close relationship between obesity and high cholesterol level and susceptibility to coronary atherosclerosis. "Any such correlation, if it exists at all, must be extremely low," he states.

Dietary cholesterol

Another very widespread misconception is that the dietary ingestion of cholesterol is a contributory factor in atherosclerotic heart disease. Again, quoting Ancel Keys, "The evidence—both from experiments and from field surveys—indicates that the cholesterol content *per se*, of all natural diets, has no significant effect on either the serum cholesterol level or the development of atherosclerosis in Man."

In their zeal to reduce the cholesterol content of the diet, many clinicians have been drastically cutting the total fat intake of their patients. I should now like to discuss some recent evidence which suggests that such a procedure may defeat the very purpose of such a diet. For a long time sporadic reports have appeared which indicated that a vegetable diet lowered the blood cholesterol level of Man, but it was not until recently that studies showed that it may be the high concentration of vegetable *fat* in the diet which exerted the hypocholesteremic effect. It has become evident in a series of recent papers from Canada (10) and from South Africa (11) that the active components of the vegetable fats are the so-called essential fatty acids. Over twenty years ago, Burr and his colleagues reported a deficiency disease in rats caused by dietary lack of certain highly unsaturated fatty acids. These have since been referred to as the essential fatty acids, although a definite role in human nutrition had not been conclusively shown. The common essential fatty acids are shown in Figure 2. They are: 1) linoleic acid, which is present in very large amounts in common household cooking oils (such as corn, peanut and cottonseed oils) and contains two double bonds as contrasted with one double bond for the most abundant fatty acids in animal fats; 2) linolenic acid (which imparts to linseed oil its drying qualities, valuable in the manufacture of paint)—more highly unsaturated and having three double bonds; and 3) arachidonic acid, still more highly unsaturated, having four double bonds; this acid is much less abundant than the others,

$$CH_3(CH_2)_4CH{=}CHCH_2CH{=}CH(CH_2)_7COOH$$

Linoleic Acid

$$CH_3CH_2CH{=}CHCH_2CH{=}CHCH_2CH{=}CH(CH_2)_7COOH$$

Linolenic Acid

$$CH_3(CH_2)_4CH{=}CHCH_2CH{=}CHCH_2CH{=}CHCH_2CH{=}CH(CH_2)_3COOH$$

Arachidonic Acid

FIG. 2. Essential fatty acids

being present largely in the phospholipides of liver, brain and other internal organs of animals.

An experiment of the type which clearly indicates the hypocholesterolemic effects of vegetable fats containing large quantities of unsaturated fatty acids was carried out by Beveridge *et al.* (10). When corn oil was fed to healthy men for eight days, there was a pronounced drop in the level of plasma cholesterol. When corn oil was continued, the level remained low. However, when animal fats were subsequently used to replace the corn oil, the blood cholesterol level rose. The suggestion has been made that these essential fatty acids play some vital role in cholesterol transport or metabolism and it has been further suggested that the high incidence of coronary atherosclerosis in North Americans and Northern Europeans is their low intake of these unsaturated fatty acids, owing to the use of either animal fats or hydrogenated vegetable oils in their diets. I emphasize, however, that these are only hypotheses. Let us remember, even if it should be proved that these substances lower the concentration of blood cholesterol, that there is no clear-cut correlation between blood cholesterol levels and coronary atherosclerosis.

Total atherosclerosis

It might be appropriate to indicate a reason which, in my opinion, may account for the difficulty in correlating the incidence of atherosclerotic heart disease with clinical data or dietary habits. Coronary or cerebral atherosclerosis—the types which make themselves clinically manifest—may not bear any close relationship to aortal atherosclerosis, which is so common in the middle-aged and elderly population as to be a well-nigh universal affliction. Every pathologist is familiar with the heavy fatty plaques, calcification, and necrosis which characterize the thoracic and abdominal aorta of the elderly person. We learn of the existence of these plaques only from the unfortunate soul who is unlucky enough to have one form in a coronary or cerebral artery; the majority of us enjoy (or suffer) the presence of atherosclerosis in our large arteries in blissful ignorance. Certainly, clinically evident atherosclerosis must be only a small fraction of the total incidence of this condition. A method of measuring total atherosclerosis in the living person is urgently needed.

CONCLUSION

It is obvious that in our present stage of knowledge there is no justification for "going overboard" on theories, and drastically altering our dietary habits. Until more information is available on the causation of atherosclerosis, a policy of dietary moderation seems the only sensible course to follow.

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NUTRITIONAL NEEDS OF MATURING MAN

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In 1493, Columbus made his second voyage to the New World. One of his crew subsequently went on to be active in Spanish colonization. Indeed, he was made Governor of Puerto Rico in 1510. Not content with this, he obtained permission from King Ferdinand to conquer Bimini which, according to maps of those days, was supposed to be a nearby island. Now this gentleman was intrigued by current rumors in Spain that there was a fountain on the island at a place called Polombe, of which Sir John Mandeville said he "drank thereof thrice" and "feel me the better and haler." So, believing that this Fountain of Youth was on the Island of Bimini, off went Ponce de Leon. That he happened to start the Florida real estate boom is an accident of history.

What this true study indicates is that in the desire of man to capture Youth, or at least to "feel . . . the better and haler," the goal was sought through a fountain—that is, Nutrition. Through the centuries, there has grown up an abundant folklore about special foods or diets which promote longevity; not the least logical is the one that recommends a nightcap of brandy or sherry.

In discussing the nutritional needs of maturing man, I bring you no new elixir of longevity, no long-acting capsule containing a concentrate of the Fountain of Youth. I should like, however, to discuss with you some of the things we know, some that we think we know, and many that we don't know at all.

SOME PRINCIPLES

If we are still seeking a nutritional Fountain of Youth, we must remember that we have been making one major assumption. We are assuming that what is good for a 20-year-old is good for everyone over that age. We have assumed, in the past, that vigorous youth represents the optimum in adjustability and potentiality and that anything that deviates is of necessity inferior, if not pathologic. We have assumed, in other words, that everything in senescence is on a decline.

Perhaps we should re-examine this concept. It is possible that with maturity come new experiences, responses and adjustments to stress which change the older adult so that he has a different base-line, a different standard with which to be compared. We should compare our senior citizens with others of the same maturity, just as in pediatrics we compare one child with another child, not with an adult.

In practical terms, this means that perhaps less research should be devoted to measurements of various functions and blood levels at different ages, and more to differences *between* individuals at various stages of maturity.

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NORMALCY

This principle, however, presupposes some knowledge of the "normal" condition; and here we face squarely the largest *terra incognita* of human biology—"What is normal?"

"Normal" comes from the Latin word *norma*, meaning a pattern or a rule. Synonyms are "model," "prototype" and "standard." It is a qualitative term; yet we hear investigators talk of the "normal serum cholesterol level in old age" when they mean the "average"—a quantitative term.

Suppose the level of a substance rises (or falls) with aging, compared to the level during youth. Does this change necessarily mean an "abnormality"? (There is a variant of the word "normal" again.) We really mean that arithmetically, the change is significantly different. But suppose the elevation is "in accordance with its inherent design" (1), as the word "normal" has been defined? I am returning to an old concept that some changes which occur in time (that is, with aging) may be in accordance with their inherent design, or "normal." It is essential to uncover these normal processes—if they exist—if for no other reason than that we may stop trying to convert every modality of the elderly alumnus to that of the college freshman.

There are many degrees of nutrition. There is no specific point below which nutrition is unsatisfactory and above which it is satisfactory. We have to go one step further and define our terms, for there are degrees of normalcy (Fig. 1). In this diagram, Bessey admirably illustrates the nature of nutrition with vitamin A in rats; but the principles are equally applicable to man.

Not only is our concept of normalcy vague and variable, but in geriatrics we are confronted by time-out-of-context. This means we are looking at only one frame of a moving-picture film—one instant in a long life. We know little of

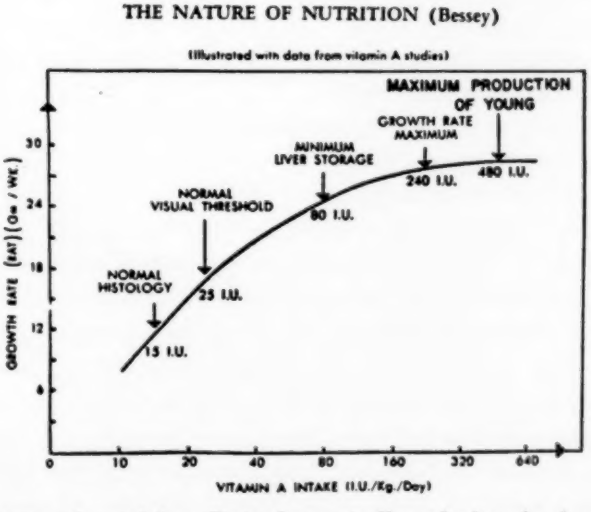


FIG. 1. The nature of nutrition. Data from studies of vitamin A metabolism in rats showing "degrees of normalcy." (Courtesy Dr. O. A. Bessey.)

what has preceded and nothing of what follows. There is, therefore, a crying need for longitudinal studies involving a careful, continuous follow-up of adults as they mature and become over-ripe.

I was glad to hear that Professor Verzár (2) in Basle, Switzerland, has organized a team to study so-called normal man for the next thirty years. The subjects are workers in a factory which has a very small turnover of personnel. By using standard technics, it is hoped that future investigators will continue their physiologic measurements. Someday we may learn from such a continuing study, what happens as a man gets old.

CULTURAL FACTORS

Not only do we not know much about the so-called normal condition or about the natural history of aging as seen in any one person, but we are often unappreciative of the great role of cultural factors.

Unlike any other branch of biologic science, nutrition is the province of every man. Everyone eats and, therefore, is an expert on the subject. Here is a process essential to life, which is connected with deep emotional urges and needs, which is carried out in a social setting, and which is dependent both on Nature and on Man. No wonder that there is a fabulous mixture of ignorance and knowledge in matters nutritional.

For example, infants in West Bengal receive diluted milk for perhaps a year, because the mothers are convinced that the children cannot digest whole milk. Similarly, some old people (perhaps in Philadelphia) don't eat beef or other so-called red meats, because they are convinced that they are not digested well by the elderly. (And so it goes.)

A few years ago, the American Dietetic Association sponsored a study of common beliefs relating to food in health and disease. Some of the more common food fictions (3) were:

—Dark bread contains fewer calories than white bread.
—Garlic causes high blood pressure.
—Citrus fruits are too acid to be handled by the body.
—Cheese and milk are constipating.
—Pork liver is less nutritious than beef liver.
—Oysters and raw eggs increase sexual potency.

It has also been pointed out (4) that there are such things as "security" foods, "reward" foods, "fetish" foods, and foods with pleasant and unpleasant associations. Nutritional matters have even become a part of our daily speech. Witness:

—If I don't bring home the *bacon*, I'll be in a *jam*.
—Let's talk *turkey*; this is a *lemon*.
—Although she's no *spring chicken*, that *tomato* is the *toast* of the town.
—That takes the *cake*!

So we see that nutritional subjects are truly a part of us, and one cannot look upon them with cold, scientific objectivity. We are dealing with a subject very close to our patients' hearts—in fact, their stomachs.

GENERAL NEEDS

It would be most pleasant to be able to state that X, Y, and Z are the specific nutritional needs of maturing man. Unfortunately, as you have gathered, we cannot—at least, not now.

What is particularly disconcerting is that we find so many old people who are mentally and physically active and still vigorous and creative, but who, according to the textbooks, should be dead. Some of these rugged individuals have ingested the most atrocious diets for decades. Steiglitz (5) mentions a remarkably healthy man of 87 who lived for fifteen years solely on a diet of bacon and pineapple juice.

Who is right? The white-robed scientist with his table of data or the clinical variant walking the street? The old saw about "the exception that proves the rule" is not an answer. The fact that there are these so-called exceptions suggests that there are factors concerned here of which we still are ignorant.

Nevertheless, if we try to summarize our present knowledge of the specific nutritional needs of the elderly, we would say that the nutritional *requirements* of the elderly are the same as, or very similar to those of the younger adult. Calories, protein, carbohydrate, fat, vitamins and minerals are all needed in essentially the same balance for the man or woman of 25, 50 or 75.

However, although the needs in health are basically similar in all adults, these needs are met in the elderly with greater difficulty. There is a higher incidence of altered nutritional status in the elderly, probably because of such physical factors as ill-fitting dentures, food allergy, chronic painful states, diarrhea, peptic ulcer or gall-bladder disease; or because of such psychologic factors as paranoia, senile dementia, depression, or alcoholism; or because of such sociologic factors as living alone (dining upon a can of beans), family conflicts, and perhaps poverty. Thus, although the requirements of the healthy oldster are not remarkable, his diet is prone to be deficient for what we may call external reasons.

We have all seen how prevalent malnutrition is among elderly patients, hospitalized for any reason. There is often a deficiency of calories and certain vitamins. However, in a typical recently reported study of 27 households composed of adults over the age of 50, there was a fairly adequate intake, as determined by food brought into the kitchen (6). Unfortunately, in this study the actual amount ingested or the amount wasted could not be determined accurately.

Incidentally, vitamin C and calcium were the nutrients in least ample supply.

Here we see, in outline, a characteristic of geriatric nutrition. Under conditions of healthful activity and positive attitudes, the food intake in most instances is likely to be satisfactory; but when there is illness or complications of a physical, psychologic or social nature, it is very easy for the aging to slip into a serious malnutritional state. In short, the homeostatic mechanisms and the reserves of the young seem to be impaired or missing in the elderly. Therefore, they need special attention when a "stress" occurs.

CALORIES

If we had to recommend an "ideal" diet for a healthy, happy, elderly person, we should probably recommend a caloric intake sufficient to keep his body weight

close to that for a man of his height at about age 20—not the caloric intake of a 20-year-old, but an intake adjusted to raise or lower the body weight to this standard level. We hold no brief for age 20; it merely represents a time when obesity has not yet become common.

This matter of calories is very interesting and complex. We may summarize our present (subject to change) concept of energy balance as follows:

Given a steady state of nutrition, an excess caloric intake of about 500 calories per day (or a reduction in physical activity, or both) will lead to a weight gain of about 1 pound per week. This is only a rough average, because the amount of energy used in similar daily activity varies considerably in rather unpredictable ways (7). This extra weight is about two-thirds fat; the rest is cellular tissue. When the extra calories are no longer eaten, the new body weight can be maintained with a smaller intake than during the active weight-gaining period. It takes fewer calories to maintain a steady state as fatness increases. At this stage, we find poor correlation between body weight and daily food intake (8).

The body has a persistent habit of adapting to extenuating circumstances. Thus, when the caloric intake is reduced, the energy expended tends to be reduced through decreased muscular activity and decreased basal metabolism. The net result of these physiologic changes is that 1) body weight, 2) caloric intake, and 3) energy expenditure are only slightly correlated.

VARIOUS NUTRIENTS

In the ideal diet, we would recommend about 1 gram of protein per kilo of body weight per day. This is such a convenient figure to remember (1 Gm./Kg.) that we have invested it with almost supernatural significance. (Here too we must be honest and say "about" 1 gram.)

An intake of about 100 Gm. of fat, or less, would be desirable. Carbohydrate would be supplied to complete the caloric intake.

Any "ideal" diet should contain "adequate" amounts of vitamins and minerals, especially calcium and iron. However, "adequate" is a hard word to define in this connection. In vitamin-mineral therapy, physicians have a unique opportunity in preventive medicine, and there is no other situation in which prophylaxis can be practiced so cheaply. I would recommend the amounts now furnished by many good brands of vitamins or vitamins and minerals; these are more than minimal amounts, and that is all to the good. Provided the amounts used are not ridiculously excessive, one can afford to be liberal.

For example, studies by Agnes Fay Morgan and coworkers (9) on 577 healthy people over age 50 revealed that men apparently require a greater intake of vitamin C than do women in order to maintain equal serum levels. More studies of this base-line type are clearly needed.

CHOLESTEROL

Now, a word about the hottest potato in nutrition—cholesterol. So much is being written and disputed regarding lipids and atherosclerosis that anything we say now may be out of date by this afternoon. Nevertheless, we can make the

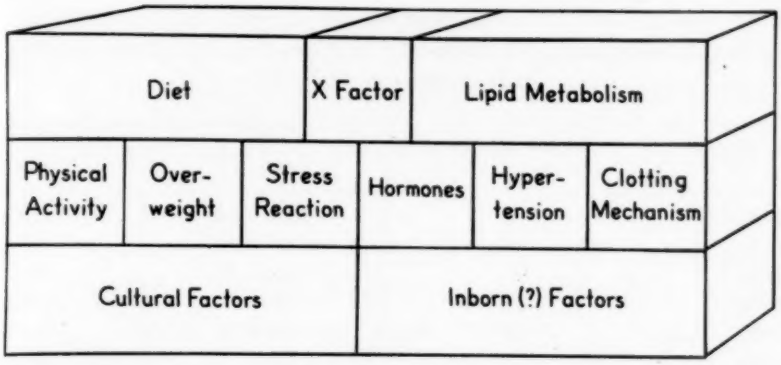
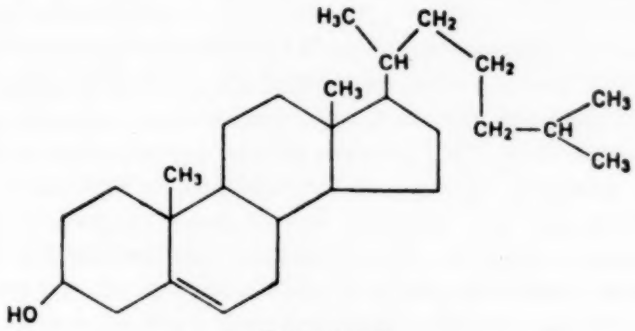


FIG. 2. Schematic representation of some of the factors related to human atherosclerosis.



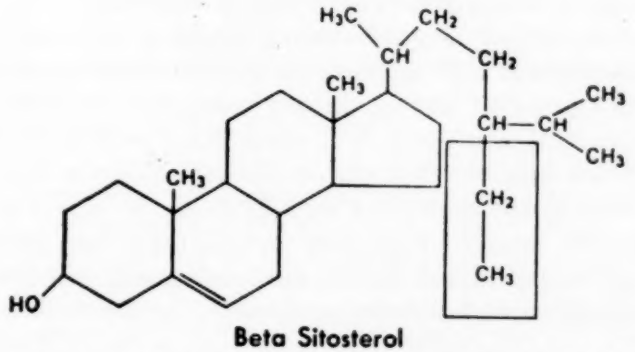


FIG. 3. Structure of beta-sitosterol compared with that of cholesterol.

following general statements: 1) fats in the diet affect the serum concentration of cholesterol and of other lipids; 2) certain lipid patterns in the blood are more prevalent in people with overt atherosclerosis; 3) these relationships are not necessarily cause-and-effect; 4) there is as yet no answer to the crucial question of whether changing these serum levels back to a more "normal" (meaning *average*) pattern will slow or stop the pathologic process, although circumstantial evidence suggests that this eventually may be accomplished; and 5) diet is but one factor in a very complex picture (Fig. 2).

TABLE 1

*The Range and Average Level of Vitamin B_{12} in Plasma of 201 People According to Age in Increments of 10 Years**

Ages (yrs.)	Number of Subjects	Vitamin B_{12} (mcg. per ml. of plasma)	
		Range	Average
31–40	2	0.35–0.94	0.65
41–50	8	0.28–0.93	0.54
51–60	39	0.23–1.60	0.61
61–70	57	0.08–0.98	0.48
71–80	54	0.06–0.93	0.45
81–90	40	0.01–1.25	0.439
91–100	1	0.36–0.36	0.36

* One of a group of studies in the literature showing some fall in the serum concentration of vitamin B_{12} in the elderly. (From Chernish *et al.* (10).)

The questions we ask are: Should the diet of middle-aged or elderly people be changed, and if so, in what direction? What advice should one give the patient who already has manifest atherosclerosis? I wish there were one good and true answer, but there is none. The best that we can say just now is this:

The current American diet is probably too high in fat (and incidentally, in salt), and there should be a reduction in this factor on general principles. But there is no guarantee that this alone will alter significantly the high incidence of atherosclerosis. There is a possibility that it may do so, and for this reason it is worth a try, because coronary disease is such a serious matter. However, we must not be positive in our belief in the magic of fat restriction *alone*. I doubt that the Fountain of Youth gushed unsaturated fatty acids.

The patient with clinically evident atherosclerosis, on the other hand, deserves every possible therapeutic aid—again keeping in mind that we cannot guarantee good results. As a practical matter, dietary restrictions are difficult, if not impossible. One practical solution is the concomitant feeding of beta-sitosterols (Fig. 3) to patients with elevated plasma cholesterol levels. One can expect a moderate reduction in the cholesterol level in about two-thirds to three-fourths of the subjects. The results I have seen with Cytellin[1] are quite good in this respect. It should be understood that we are treating only one measurable manifestation of a complex metabolic disease, namely, the serum cholesterol level.

VITAMIN B_{12}

The role of vitamin B_{12} in the nutritional needs of maturing man is just being realized. Recent reports (10) have suggested that plasma levels of vitamin B_{12} are lower in the aging than in the young (Table 1). In an occasional case (perhaps 2 per cent), there will be impaired oral absorption of the vitamin, presumably because of a partial deficiency of intrinsic factor. In these subjects, there is no evidence of pernicious anemia as we understand the term today.

[1] Sitosterols, Lilly.

Feeding concentrates of intrinsic factor together with vitamin B_{12} to these elderly people (who are usually achlorhydric) brings the plasma vitamin B_{12} levels up to the average. Is this *pre*-pernicious anemia? Or is there still another clinical entity of partial vitamin B_{12} deficiency, especially among elderly achlorhydric subjects? Work now under way in several laboratories may furnish the answer some day.

THE NEEDS OF MATURING MAN

In the past, nutritional research has had as its theme the prolongation of life. The life span of rats (McCay) is a classic example. However, in man, as Jules Rostand (the French biologist) put it: "*Everybody wants to live longer but nobody wants to grow old.*"

We should, perhaps, adopt the philosophy of Johann Heinrich Cohausen, who died in 1750 at the age of 85. He said "Some misguided enthusiasts have believed that by lengthening life they would confer a priceless boon on the human race; forgetting that it is not the length of the day which makes us love the summers, but the brightness of the sun, the beauty of the flowers, the singing of the birds."

Perhaps the specific nutritional needs of maturing man are ultimately less significant than his attitude. More than one hundred years ago, Sir John Sinclair wrote in a Code of Health and Longevity:

1. Breathe pure air.
2. Use a moderate proportion of liquid food.
3. Consume no more solid food than the stomach can easily subdue.
4. Preserve the organs of digestion in good order.
5. Take regular exercise without fatigue.
6. Sleep as many hours only as may be necessary to restore the strength of body and mind.
7. Control the passions and bear with fortitude the disappointments of life.

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Panel Discussion on Energy Maintenance; Research Conference on Maturing Man, Growth and Aging. (Left to right) Doctors McCay, Weinhouse, Waife and Reimann (Moderator).

PANEL DISCUSSION ON ENERGY MAINTENANCE

RESEARCH CONFERENCE ON MATURING MAN, GROWTH AND AGING

Moderator: STANLEY P. REIMANN, M.D., Director Emeritus, The Lankenau Hospital Research Institute; Scientific Director Emeritus, The Institute for Cancer Research, Philadelphia, Pennsylvania.

Panelists: SIDNEY WEINHOUSE, PH.D., Chairman, Division of Biochemistry, The Institute for Cancer Research and The Lankenau Hospital Research Institute, Philadelphia, Pennsylvania; CLIVE M. MCCAY, PH.D., Director of Nutrition, School of Agriculture, Cornell University, Ithaca, N. Y.; S. O. WAIFE, M.D., Editor, American Journal of Clinical Nutrition, Indianapolis, Indiana.

DR. REIMANN: I should like to ask this question of anyone on the Panel who would like to answer. In the treatment of various diseases, especially cancer, we give so-called anti-metabolites—drugs which interfere with the production of such things as nuclear proteins, for instance. The question is this: How much attention should be paid to the food which people eat when they are receiving these anti-metabolic drugs? Is it important or not? And, if so, to what degree?

DR. WEINHOUSE: I think it's important, but I don't think we have any information on the subject. The question has brought up a very good point. One of the things that I have been interested in is why anorexia develops so early in patients with carcinoma. It's quite characteristic, as you all know. It is problematical whether the anorexia is the result of excessive tissue breakdown, whether it is due to excessive amounts of certain acids that have been broken down in the tissues, or whether there are substances (in a sense, like metabolites) which in themselves may be causing it. It is a completely uninvestigated area.

DR. REIMANN: But worthwhile investigating. I have another question: I am asked by people from time to time what in the world is the use of taking vitamin pills when we eat plenty of carrots, oranges and so forth. Whether correct or not—and that's what I am going to ask you—my stock answer is that it depends to a considerable extent on what soil the carrots or oranges are grown in. Since we each can't have a chemical laboratory at our dinner table to determine how much vitamin is in each particular carrot or orange, it is a good thing to take vitamin tablets and hope to goodness that the carrots and other vitamin foods you eat have been grown in good soil. If they have, a few extra vitamins won't make much difference except in a few instances. What about it, Dr. McCay?

DR. MCCAY: I think that if we choose our diet well we need pay little attention to vitamin tablets. The point is that we are so subject to our foibles and our bad food habits and we are so undisciplined in our choices, that we tend to select bad foods all the time. An example is the eating of 100 pounds of sugar per capita per year, and of all those fats mentioned by Dr. Waife. As a result of that sort of practice, many people need vitamins and should take them. However, if they followed the other practice, I am very doubtful that they would need vitamins at all.

DR. WAIFE: Dr. Reimann, there is a recent report by the U. S. Department of Agriculture on a direct-questioning survey in, I think, 6,000 or so American households in which they analyzed the food intake over a week and correlated the findings with the income of the group. The results were quite amazing. There was a surprisingly high percentage of inadequate intake, even before cooking and processing of foods, but this was not very closely related to the family income. Something like 10 per cent of the people whose income was $10,000 a year or over after taxes still did not meet the National Research Council's requirements with regard to the intake of vitamin A or C—I don't remember the details. In any event, there is a surprisingly high prevalence of deficient intake of vitamins.

DR. REIMANN: Quite a few years ago when my daughters were going to school here in Philadelphia (Germantown Friends' School, as a matter of fact), there was an extensive survey of the nutrition and the general build of children in Philadelphia. I thought our youngsters were fed very well indeed. However, who do you think took the first prize? Some little Italian boy who lived in a relatively poor neighborhood and whose folks certainly weren't getting as much as $10,000 a year, either plus or minus taxes. I guess spaghetti and bouillabaisse, or whatever it is, was very good for him.

I have several questions here and they all have to do with fatty acids. Suppose I read one or two. Would you advise extra essential fatty acids? If so, in what dosage, and in what type of patient would you administer it? How much fat did Dr. Waife recommend?

Dr. McCay, would you comment further on the value of potatoes in the diet? And here's another one—How effective are the newly introduced products for reduction of the serum cholesterol level? Who would like to start answering? Dr. Weinhouse?

DR. WEINHOUSE: From my knowledge of the composition of natural foodstuffs, I should say that a person who eats a normal diet (even with all the uncertainties involved in this term) can hardly avoid getting sufficient unsaturated fatty acids. They are ubiquitous in all of our vegetable foodstuffs, and not entirely lacking in animal fats. At the present time, there is a great deal of work going on in an attempt to determine the dietary quantity of these unsaturated fatty acids which is optimal for lowering the blood cholesterol level. This may supply some information regarding possible therapy with unsaturated fatty acids. The relationship between the cholesterol concentration in the blood and the incidence of arteriosclerosis is not known as yet; until this is certain, there seems to be good reason for hesitation concerning the efficacy of lowering the blood cholesterol level. In fact, just a few moments ago, Dr. Drabkin reminded me of something which I perhaps should have mentioned in my talk, namely, that lowering the cholesterol content of the diet may also defeat the purposes for which the diet is changed, because it is now known from metabolic studies that when cholesterol is fed, the rate of synthesis of cholesterol is lowered in response, and if cholesterol is kept out of the diet we are defeating our purposes by causing a greater synthesis of cholesterol. I might emphasize that the amount of cholesterol which can be synthesized in the body is far greater than the amount of cholesterol we usually ingest in a normal diet.

DR. REIMANN: Dr. Waife, any comment?

DR. WAIFE: No. I am not sure we have answered the question, which is a very difficult one, and I think that we do not have enough evidence now to make positive statements as to whether or not fatty acids should be added to a diet. That doesn't help the questioner, but I think it is a fact.

DR. REIMANN: Any pertinent comment? Dr. McCay?

DR. MCCAY: I have here a number of questions that are going to take a long time to answer. Shall I read the questions? We are having lunch, you know, and there is no reason why you can't buttonhole some of these folks during or after the luncheon. Do you have an explanation for the increased production of lactic acid that is observed in cancerous tissues? Dr. Weinhouse?

DR. WEINHOUSE: This is a very controversial field. The high production of lactic acid was, for a long time, believed to be due to an impairment of respiratory enzymes in the cells—a view which was proposed by the eminent German biochemist Warburg some thirty years ago. Recent work from our own laboratory and other laboratories has discounted this explanation, but it has not solved the problem. We still have the high production of lactic acid, and it is one of the few biochemical anomalies, if you want to call it such, of the cancer cell. It is important to find the cause. There is some evidence indicating a possible difference in the cellular membrane which makes the cancer cell more permeable to sugar. This may partly or completely account for the high lactic acid level, but we just don't know at present.

DR. REIMANN: There is another question here—What is the relationship of the phospho-lipid ratio to atherogenesis?

DR. WEINHOUSE: I can answer that simply by saying that no correlation, either high or low, has been found between any lipid measurement and atherosclerosis.

DR. REIMANN: Here's an interesting question—Please mention the role of water in nutrition. Dr. McCay?

DR. MCCAY: I'm sure that question comes from Dr. Steiglitz, who believes it has a profound effect. I agree with him heartily. We have made many fluid ingestion studies of different sorts, and I am sure we know very little about the role of water in nutrition. I agree with Dr. Steiglitz that if we knew more about water we would know more about how to control constipation, and many other factors that we don't handle adequately today.

DR. REIMANN: I'm glad that all three of our speakers have brought up the difficulty of distinguishing between heredity and environment in this business. We are always up against that. Do you know the story of the frizzled fowl? The Chinese have raised frizzled fowls for centuries as pets. These chickens have their feathers sticking out at all angles so they call them frizzled fowls. They have half as many feathers as a normal chicken, so they lose more heat. In order to make up for this loss, they have to eat more and burn up more to produce the heat; therefore they have bigger livers and gizzards. They also compensate by an increased rate of blood flow, so they have large hearts. In order to supply the necessary enzyme—correct me if I am wrong in this, as pathologists always rush in where biochemists and others fear to tread—they have to have more thyroid

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secretion, so they have a goiter. To cap the climax, they're pop-eyed. Thus, they have all the classic symptoms of exophthalmic goiter—increased basal metabolic rate, increased blood flow, hypertrophy of the heart, a goiter, and exophthalmos. What do you think is the cause: It is all due to changes in just one chromosome area. It goes to show how hard it is to fathom the relative roles that heredity and environment play in any particular phenomenon we happen to discuss. I notice that it has come up quite often in this panel. The conclusion is that it is very desirable to have chosen good grandfathers, good grandmothers, good great-grandfathers and good great-grandmothers, and so forth.

What do you say about that, Dr. McCay?

DR. MCCAY: It is extremely important, as I was trying to stress this morning, that we not only know about the genetics but about the sex and the environment. If we are going to do good work in the future, we have got to have groups of cooperating scientists, highly specialized, amalgamating their efforts. I don't believe we can do full justice to the problem as individuals any more.

DR. REIMANN: That's a very profound statement you just made. The day of the experimenter—with a rabbit in one hand and a hypo in the other—isn't quite over; but at any rate the situation is such that a lone individual has a hard time these days. There's no question about it. Teamwork is needed to attack these complicated interrelationships and interreactions which take place as a result of our living, and which are taking place in us right now because we drank some coffee—with a bit of sugar or a bit of milk in it. When it comes down to brass tacks, goodness only knows what is happening. The panelists will tell us more about it and Dr. Weinhouse has told us a great deal this morning, but a vast amount remains to be discovered.

There is one other question I should like to ask, and it is this: suppose a young animal or a young child is not fed exactly correctly. It is possible that compensation may occur and that there are shunts in the normal metabolic paths?

DR. WEINHOUSE: Oh, yes.

DR. REIMANN: Is it true, as I have been led to believe, that this can be reversed and the normal pathways can be opened again, but only for a certain length of time? After what we heard about the word "normal" today, I am afraid to even whisper it. Anyhow, is it possible for the regular pathways to be reopened after they have been closed, if the proper diet be fed sometime later?

DR. WEINHOUSE: This is a very difficult question to answer because it is almost impossible to make any predictions as to metabolic pathways from nutritional study. We can only grasp certain inklings with our present knowledge. In the case of sugar, for example, there are different pathways of metabolism. A great deal of work is going on at the present time in an attempt to establish what types of carbohydrate disturbances occur in certain disorders such as diabetes, and whether different pathways of sugar metabolism are followed. We don't know enough about it to make any categorical statements. There seems to be some evidence that there is a general failure in synthesis of fatty acids in diabetes. There is some ground for believing that this failure is due to a lowering in the rate of conversion in one of the metabolic pathways of glucose in the liver, but the data are not sufficient to confirm this hypothesis as yet.

An interesting fact has been established recently. When nicotinamide is fed in very large doses (much larger than normally taken in the diet, even with vitamin pills), the amount of one of the co-enzymes involved in sugar metabolism—diphophopyridinenucleotide (DPN)—is increased enormously in cells. There is no doubt that this increase must cause all kinds of changes in the pattern of metabolism in the liver. A great deal of work is being carried on in order to determine what these changes are. This is one of the most interesting links between nutrition and metabolism, and indicates a fruitful area of research.

DR. REIMANN: Are there any other questions? Dr. McCay, someone asked you to elaborate a little on the value of potatoes in the diet.

DR. MCCAY: I can't give a lecture here on potatoes, but ever since I first studied nutrition under McCollum in 1923 I was very impressed by his lectures on the value of potatoes in the diet of peoples such as the Poles, the Irish and the Ukrainians. In the years since 1923, each time I have performed an experiment involving potatoes, my great respect for that foodstuff has gone up and up. I can cite a whole series of experiments we conducted when we developed the diet for the spastic feebleminded in Newark Hospital, and tell you how well those children did when we put a large amount of potatoes in their diet. When I was radiating potatoes for the Army and feeding them to beagle pups, what superb beagles were produced! And my rat experiments have yielded rather unusual results in regard to the life span. You would think I was subsidized by the potato industry! As far as I know, the potato industry has never spent any money for research. Our last experiment was subsidized by the milk industry, but we came out with potato results. It was good for the potato, but I don't think we did anything for milk. I have come to feel what a superb food we have in the potato, and I am very pained to see people becoming more and more unwilling to prepare baked and boiled potatoes, in which we get the full nutrient value.

DR. REIMANN: Dr. Weinhouse, do you have another question?

DR. WEINHOUSE: I have one here which asks—Can you predict how test-tube cancer detection tests will develop, based on your work in cellular metabolism? Nothing in our work is leading to such a test. However, I think most workers in the cancer field agree that there are possibilities in this direction. For example, the fact that tumors produce large amounts of lactic acid, and the possibility that some of the enzymes which account for the formation of lactic acid may be produced in abundance in the cancer cells and enter the blood stream, may form the basis of a blood test for cancer. Many attempts have been made in the past and changes in the blood have been found, but these have not reached the stage where they can be used as a clinical test. There has been a re-awakening of interest in the detection of enzymes in the blood. This has been principally due to the finding that transaminase, one of the fundamental enzymes in metabolism, is increased during coronary occlusion. If some enzyme from tumor cells can be found consistently in the blood of cancer patients, it may enable the early detection of this disease.

DR. REIMANN: So much for that. Dr. Waife, have you a question?

DR. WAIFE: There is one here that can't be answered, but I think it is very interesting—What would you advise for persons who are obese but who are

apparently unable to lose weight when receiving a low-calorie diet (800 to 1,000 calories a day)? Strange to say, there are more and more data indicating that patients receiving a restricted diet will lose more weight or lose weight more rapidly, when the diet contains a higher proportion of fat than has been considered permissible. In one of the current issues of "Metabolism" there is an interesting study in which patients were maintained on isocaloric diets of 1,000 calories; in three regimens, the diets were either exclusively 90 per cent protein, 90 per cent carbohydrate or 90 per cent fat. This work was conducted by careful workers and the results seemed surprising—that the greatest weight reduction occurred during intake of a diet high in fat but low in total calories. This may rub against the grain of orthodox metabolic teaching, but the evidence is so clear and so important that we had better re-examine some of our concepts. Although I cannot advise what to do with a person who fails in a proper attempt to lose weight, I would say that the easy recommendation of a 1,000-calorie diet, ignoring all other factors, is probably not the answer.

DR. REIMANN: Dr. McCay would you like to answer one more question? Are there species differences in experimental dietetic study? If so, how can the result of such studies be applied to man?

DR. MCCAY: Unraveling the secrets of species differences offers a great opportunity for study. We can select a species that is very subject to some pathologic change that also occurs in man; on the other hand we may have a species that is very resistant to this change. How does one animal prevent that pathologic lesion, and why is the other animal overwhelmed by it? There are great restrictions in application in the transition from animals to man. Nevertheless, when we have no valid data upon man himself, the results of animal experiments are a better guide than no results at all.

DR. REIMANN: Good answer. Thank you very much, folks. We shall continue our program in about thirty seconds.

PHYSICAL FITNESS

KAARE RODAHL, M.D.*

Lankenau Hospital, Philadelphia, Pennsylvania

This paper is an attempt to discuss the significance of physical fitness with particular reference to age.

AGE

Age is a relative concept. It changes with the individual as he grows older; it changes with time from century to century, and it varies from one culture to another. In ancient times an old man was young by our standards, because of the shorter life span. In some primitive cultures chronologic age is of little or no consequence. An old primitive Eskimo does not know how old he is. They kept no records of their births nor did they celebrate birthdays.

In the Eskimo society the men continue to grow in usefulness and importance to the group as they age; they grow in prestige, influence and economic importance. The old men are the best hunters; they are the first to spy the game and they know best how to get it. Because of their wisdom and knowledge of the ice, the tundra and the habits of the game animals, they are respected by the young, who ask their advice and accept their guidance and their decisions. Their word is law as a rule; they are the leaders who are needed by the settlement and they have a feeling of being needed and respected. Thus they continue to be useful members of the tribe until they themselves begin to feel that they are getting old; then they rapidly wither away.

This seems to be a sensible philosophy, based on the concept of biologic aging in contrast to the trend in our own civilization.

Here the emphasis is on chronologic age. Birthday celebration has become an important tradition and so we are continuously reminded of the added years. Our children are allowed to play their way through school until they reach college age, when the need for hard work suddenly becomes apparent. We spend a lifetime preparing for a profession and become wise far too late in life. At the age of 50 a man is no longer in demand; at 65 he is usually forced to quit and thus withdraw his world of knowledge and his lifetime of experience, regardless of his fitness for physical and intellectual work.

CULTURE

In the ancient Greek culture the man was great who could write immortal poetry with the same hand he used to place the Olympic laurels on his head. The combination of physical fitness and intellectual maturity was a must, and the Greeks were trained with this aim in view from early childhood. The same was true in the Viking Age. In the primitive Eskimo culture of today the rule of the survival of the fittest still holds. Indeed, in Arctic survival, physical fitness is the

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factor which in the final analysis determines life or death, because during prolonged periods of exposure to extreme cold we are unable with our present means to protect an inactive man so as to maintain thermal balance. He has to rely on physical exercise to increase his heat production. Consequently he who has the ability to maintain high levels of physical exercise longest has the greatest chance of survival.

In the case of the Eskimos and other primitive tribes, physical conditioning and training start early in childhood and are usually maintained throughout life. As judged by a standard physical fitness test administered at the Arctic Aeromedical Laboratory, the ratio of physical fitness for the average Eskimo, the well trained Arctic soldier, and the average airman was in the order of 3.5:2.5:1.0.

With the increasing technical complexity of our modern civilization the emphasis on physical fitness and capacity for physical work is rapidly declining. In Scandinavia, physical exercise, outdoor activities and sports involving a variety of muscular work are still a traditional part of their culture. On week-ends thousands of families hike into the hills. Physical exercise is part of their recreation and adds to their joy in life. Children must use their muscles to get to school. In the areas where there are no movies or television, the youths must seek enjoyment and recreation by more natural means.

In the more advanced American civilization, on the other hand, there is little chance of using one's feet. There is hardly any place to hike or to ride a bicycle in the heavy traffic. The children are carried to school in busses. The multitude of technical gadgets is apt to tax their time and interests to such an extent that the cultural and biologic aspects of life are neglected.

Whereas in the ancient Greek culture, thousands of persons were actively participating in athletic performance on the sports grounds, nowadays passive spectators by the thousands sit and watch a small group of 22 men kick the ball about on a football field.

The trend in development is obvious. If this trend continues, one can imagine what the state of human physical fitness will be in the year 2000.

In the light of this trend in the development of our culture, one may be justified in asking—What does physical fitness mean to man?

PHYSICAL FITNESS

The need

It must be admitted that our present knowledge of the physiology of exercise is far from complete. However, it is well established that physical conditioning increases the muscle mass, causes increased vascularization of muscle tissue, and increases the overall metabolically active mass (1). The total blood flow is increased by the greater cardiac output. There is increased power, efficiency and endurance of the skeletal muscles, and increased efficiency of lung ventilation (2). This means that the usual types of daily activity can be carried out with less fatigue. This in turn means that the fit man returns to his family less tired at the

end of the day, and can therefore devote himself with greater vigor to his family, which in all probability makes the children happier and the wife more content.

It has been pointed out that exercise serves to divert the mind into fresh channels and provides an emotional outlet for the worries of daily life, especially in the later years. Furthermore, vigorous physical activity tends to eliminate overweight and obesity with all their medical complications.

It has been repeatedly observed that a physically fit person can get along better without sleep than an unfit person. When, in addition, fitness increases endurance, it becomes a vitally important factor in case of a national emergency.

In the light of the modern concept of global wars, it is apparent that our survival as a nation will depend greatly upon our capability for industrial survival, *i.e.*, the ability of large proportions of the population to survive and to carry on vital functions in the face of food and water shortage and under strenuous physical conditions. From this viewpoint alone we can hardly afford to overlook the apparent need for higher standards of physical fitness for all age groups of the population.

Influence of age

How, then, is physical fitness affected by age?

Åstrand has recently written an excellent review of this subject (3). It has been demonstrated that young people are superior in the performance of exercises which require bursts of intense activity, but that older people may demonstrate greater endurance and superiority in sustained activity of more modest intensity (4). Morehouse and his associates (2) state that man's best performance during intense activity is attained between the ages of 18 and 25. They point out that after the ages of 25 to 30 the capacity for intense effort slowly decreases, whereas the capacity for endurance may suffer little impairment provided some degree of training is maintained.

There is a gradual decrease in the capacity of oxygen intake after 20–30 years of age. Robinson (5) has shown that the mechanism for utilizing oxygen in exhaustive work is only about 50 per cent as effective in a man of 75 as in a boy of 17. The pulse rate possibly decreases somewhat in older people. The blood pressure increases with increasing age. During work at a fixed level, the pulse rate and systolic blood pressure are higher in older than in younger people, as is also the blood lactic-acid level (3). There is a gradual decline in vital capacity with age. Respiratory and circulatory adaptation occurs more slowly in older than in younger people, when performing muscular work. In the transition from rest to work, old men lag behind with respect to acceleration of the heart beat and the increase of oxygen intake (5). Older people show a more sluggish reaction to environmental stress than do younger people. Muscular strength declines with age, and nerve impulses are slower in older people (3).

All those phenomena are factors which may cause a decline in physical fitness and performance as a consequence of aging. The important question, as Åstrand has pointed out (3), is whether or not these changes are inevitable results of the

added years, or whether they can be avoided (at least in part) by regular physical exercise.

Jokl and his Finnish collaborators (6), in their review of sports in the cultural patterns of the world, are quite optimistic in this respect. They emphasize the vast potentialities of middle-aged and older persons in physical performance, stating that "on the basis of favourable endowment and good environment, physical training may render an adolescent boy or girl maximally efficient physically and enable him to maintain a high level of bodily fitness until near the end of his life." Our experiences among men who habitually maintain a high level of physical exercise support this optimism. Furthermore, Karvonen has pointed out that in the Finnish lumberjacks' competition, men over 40 years of age were among the best (6).

It should also be noted that according to the studies of Müller and his associates at the Max-Planck Institute for work physiology in Germany, it takes very little effort to maintain physical fitness, once attained (7).

It appears from these various observations that in order to add usefulness and joy to age, we should include physical fitness. This means some form of physical training from early childhood. What a man is at the age of 70 depends to a great extent on what he was and what he did earlier in life, due to adaptation to environment, diet and modes of living.

The individual difference in physical performance in the higher age group is considerable. I have seen an Eskimo who was said to be 75 years old perform a drum dance with vigor and endurance far superior to that which could be demonstrated by most men at 30. Obviously, mandatory retirement at the age of say 65 does not take this individual difference into account.

Criteria of biologic aging

The question then presents itself—How can we intelligently establish criteria for the determination of biologic aging?

In the study of human aging, the need exists for well defined criteria for the measurement of physiologic changes with advancing age. Age is obviously an important variable in biologic experimentation, and yet comparatively little information is available regarding the physiologic response to stress and environmental exposure in the higher age groups. Most of the studies have been made in young people.

It would seem obvious that the maximum efficiency of an individual depends upon the optimal function of the total man, *i.e.*, the combined result of his intellectual abilities, his capacity for physical work, and the state of his organ functions.

Since these factors change with age, it would seem desirable to be able to correlate the relative state of these factors with age by developing a series of standard tests, the combined results of which would represent a factual index for biologic aging. Such an index would be an approximate guide for the evaluation of individual performance in health and disease, and a yardstick for the selection of

personnel for certain industrial tasks, professions, and job assignments, as well as for the determination of a reasonable retirement age on an individual basis.

The latter may be of particular significance, since there is little scientific basis for mandatory retirement, say at age 65. When no such mandatory retirement is exercised, it is a difficult task to make a fair and intelligent recommendation concerning retirement in individual cases solely based on clinical judgment without supporting data allowing a comprehensive assessment of the person as a whole.

As part of our research program at Lankenau Hospital, we hope to pursue this problem further. On the basis of systematic studies of a representative population sample, representing the average, the prematurely aged, and persons who have demonstrated unusual performance and absence of signs of deterioration in the higher age groups, an effort will be made to determine an index of biologic age versus chronologic age, taking primarily into consideration the following factors:

1. Physical performance capacity, *i.e.*, physical fitness, the capacity for physical work, energy metabolism, and nutritional state.
2. The reaction to stress, *i.e.*, endocrine and general physiologic response to standardized environmental stress.
3. Organ function, *i.e.*, clinical evaluation of general health and the functional state of the various organ systems, based upon the results of specific clinical and laboratory tests.
4. Psychophysiologic status, *i.e.*, intellectual maturity, intelligence, motivation, alertness, retainability, adjustability, judgment and psychomotor functions.

Successful efforts along these lines, mostly limited to the physiologic aspects, have already been made in several laboratories.

This concept may offer a useful basis for a multidisciplinary approach to the study of the complex problem of human growth and development.

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MENTAL HAZARDS OF AGING

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The two poles of life, infancy and old age, are appealing in their helplessness and call forth the utmost in scientific and humane understanding and care. As far as old age is concerned, medical science has achieved a brilliant record in prolonging the life span. But unless we find ways and means of prolonging the life of the mind and personality, infinitely more precious than the body, then the lengthening of the life span becomes a curse rather than a blessing. The finding of such ways and means ranks high on the priority list of medical research.

BEHAVIOR IN OLD AGE

Behavior in the old age psychoses and, indeed, the nonpsychotic mental behavior problems of old age may be regarded as distortions produced by three pressures:

1. Pathologic lesions in the brain.
2. The previous personality.
3. The environment.

Cerebral pathology

The supreme organ of man, the brain, occupies relatively a small space. In it are represented all of our motor, sensory and psychic functions. Destroyed brain tissue cannot regenerate; thus a small lesion, if it is in an important functioning area, may be extremely destructive. On the other hand, an extensive pathologic condition involving so-called silent areas may have very little effect on behavior. A friend of mine, an eminent neuropathologist, studied the brains of 20 old people without knowing their life histories. In 10 there had been definite mental symptoms; in the other 10 there had been none. Yet there were just as many pathologic lesions in the brains of those who had been free of mental symptoms as in those who had been mentally sick.

We should not be too glib about blaming all the behavior manifestations of age-old disorders upon organic brain disease. It is not the sole cause. Nor should we be too glib about linking chronologic age with mental deterioration. Some people manifest deterioration in their fifties, and indeed there may be profound deterioration in the early forties—presenile dementia. Yet we know people in advanced life (80 years of age and more) who, excepting for a few memory lapses, are bright and alert. Urgently do we need the solutions to these problems of behavior.

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Familial influence

What about familial influence in determining the time of the mental break? I have known families in which there was a consistent pattern of deterioration in the early sixties. But it is not an inflexible rule and does not have scientific validity. In some families the pattern is regarded as inevitable, and an air of hushed and gloomy expectancy pervades the home whenever one of the family approaches the fatal age. So it was in Aunt Jane's family. As Aunt Jane turned 60 the family looked at her as though they expected her to break into a cackle of insane laughter at any moment. Aunt Jane lived to be 73, bright, alert and free from mental symptoms. Again we need more answers.

The personality

The human personality is the most awesome thing in all the world. It is too fluid and far-reaching to be confined in a cage of words. At birth we bring into the world the core of personality derived from inheritance. After that it grows and is ever changing, never the same and always different from any other personality. Early in life it changes rapidly, later in life slowly, but it is never static. At any cross-section of life it contains the condensed record of all the person's previous life experiences and even of the thoughts. It is therefore not surprising that the personality is dominant enough to show its hand above the havoc of brain damage. It is the remnants of the previous personality and not the cerebral pathologic lesion that determines the type of old-age psychosis, whether excitable, euphoric, depressed, irritable, suspicious, or paranoid. The former personality, too, shapes the varying dispositions of nonpsychotic old people—pleasant and amiable, crochety, or irritable. Once I asked 2 old ladies who were afflicted with about the same amount of memory failure, the day of the week and the date. One, who no doubt had been gentle and anxious to please in her previous life, said: "I'm ashamed. I can't remember." The other, who probably had been rather aggressive, answered: "None of your damn business Find out for yourself."

The environment

The factor of environment is important. Too many families do not understand and will not cooperate in executing helpful programs and in teaching good habits, so important for the patient as the years go on. Sometimes the attitude is overly sympathetic. No matter how outrageously the old person behaves it is overlooked and even encouraged. "Poor Granny, she has nothing left in life. Let her do whatever she wants." Such a completely permissive attitude is not good either for Granny or for the environment.

More often the attitude is unkind or even cruel—sometimes in a negative way by completely disregarding the old person, or in a positive way, by intimidations, threats and physical blows. Naturally the confused old person becomes more confused and hostile and unconsciously retaliates by worse behavior. Families need much more education and guidance.

Sometimes industry makes—perhaps is compelled to make—employment distinctions that are too rigid. There is much work that old people can do, and do well, perhaps more slowly than the young but often more carefully and with fewer mistakes.

Education for old age

In the area of normal old age, education and wisdom are needed. Some old people do not accept the increasing toll of their years. They try to outdo youngsters in sports and other activities, take large amounts of sex hormones and not infrequently, on a broiling hot day, drop dead on a golf course. In all this there is considerable narcissism. A woman I knew had every mirror in the house removed on her sixtieth birthday.

There is another larger group of oldsters who submit too readily to the psychologic tyranny of their age. They would like to do this or that and could do it, but, "No, after all, I am no longer young, it wouldn't look right." They have sentenced themselves to being old. There is a way to grow old gracefully. It involves emotional maturity. Mature people live each epoch of their lives with satisfaction and pleasure to themselves and others. With reasonable adequacy they meet its responsibilities. As they pass into another epoch, they bring into it from the previous one, the good and useful things they have learned. They are prepared to take the best things from both the new and older period of life. These people really mean it when they say: "It was fine being 20 or 30, or 40 or 50, but I wouldn't want to go back to it now."

PATHOLOGIC SYMPTOMS

I do not want to give a text book description of pathologic symptoms in old age. They vary enormously in severity.

Cause

Only a part of the causation resides in cerebral pathology. Much more lies particularly in the areas of nutritional chemistry and cerebral metabolism and awaits investigation.

Mental capacity

There is likely to be some degree of reduction of mental capacity, with weakening of recent memory and faulty judgment. This may lead to the dissipation of financial resources and to the drawing of unduly influenced wills. A guardian of the estate may be needed.

Emotional reactions

There is loss of depth in emotional reactions. Trivial happenings may raise a storm of vehemence and abuse. The horizon of emotional life retreats, outside interests shrink, and self assumes overwhelming significance. Family calamities and world catastrophes are apt to elicit only a minor chord of emotional response. Anything pertaining to self may precipitate a major emotional reaction. For

example, one old gentleman flew into a violent range and smashed the dinner dishes, because his coffee cup had not been filled to the brim. *He* wanted it that way even though he invariably slopped the coffee over the table cloth.

Ethical and moral standards

There is always danger of these standards being lowered. A man or woman who has led a long life of constructiveness, integrity and honor, in a few weeks may undo it all, dishonoring himself and disgracing his family. There may be sexual advances in public, and perverted practices and indecent exposure, sometimes before children. The patient may become the victim of unscrupulous "gold diggers." The last scene of life may be a sad spectacle.

Tolerance to drugs

Generally speaking there is decreased tolerance to alcohol and narcotic drugs, and small amounts may produce confusion and even mild delirium. However, judiciously prescribed, small doses of alcohol are often helpful in making old people more cheerful.

THERAPY

In the field of prevention and definitive therapy, more information from research is eagerly awaited. At present we cannot offer much more than token measures. I have long since been convinced that many old people could be spared the ordeal of senile mental disturbances, or at least could have them deferred for a long time. The brain cells of old people are tired. Without being too artificial about it or encasing oldsters in glass houses, it is still possible to provide a reasonable amount of insulation against the too-stern rebuffs and sharp vicissitudes of life. It is not possible, nor would it be wise to conceal from them, the problems and troubles of their family and of the world; but these need not be painted in the darkest and most somber colors. The good things in life should be stressed and even dressed up a bit.

Serious, and sometimes even relatively slight physical accidents and illness, often seem to precipitate senile mental symptoms. Unless it would be decidedly dangerous, it is a good plan to get old patients out of bed or at least into a sitting position as soon as possible. This is notably true in the case of hip fractures.

Some senile patients must be in mental hospitals; but the many who are in hospitals and need not be, is a reflection upon our culture. Sometimes the reason is economic—everyone in the family has a job and there is no one to look after the old person—but far too often, the family does not want the bother and trouble. Much education is needed in this area.

Direct therapy is limited. However, there are a thousand and one practical chores to be done, such as relieving irritated skin, or hemorrhoids or bladder irritation, and making sure that the teeth are well brushed and cared for, the patient's body is clean and the clothes are neat. The doctor who considers himself superior to seeing that these considerations are carried out does not belong in the honorable Guild of Hippocrates.

It is amazing how much we all think of the "creature comforts" of life and see that we get them for ourselves; yet how often we forget to see that our old people have them. We should be sure that they, also, are comfortable and secure as to food, warmth, and common dangers. Too often we do not remember that the old, mentally dulled patient no longer is vigilant in the functioning of his sense of self-preservation. There should be available proper, easily digested food and enough body and bed clothing to protect against cold. Old people chill easily. They mislay all manner of things, and we should not be too impatient about helping to find them. Old people may readily trip and fall, or choke on too large a piece of food. Sometimes one of their fears is that their small possessions, precious to them, might be stolen at night; so they may wander about the house at night, perhaps lighting matches to find their "things." Their memories being very short, they may forget to blow out the matches, and thus set the house or themselves ablaze. They may wander away from home, taking up with strangers and telling them interesting but usually untrue stories of ill-treatment by the family.

Medicines of various sorts are often needed. These include vitamins, suitable laxatives, small doses of carefully selected sedatives for insomnia, and a trial run with some of the newer drugs which may favorably influence brain metabolism.

We need to adopt a more middle-of-the-road policy toward our old people, though not to the extent of the ancestral worship of the Chinese. After all, we cannot live in the past with the older generation. On the other hand, the cynical disregard of helpless old age by the enslaving dictatorships of our day is not good either. Nor is the problem solved by the vote-getting expediency of old-age pensions. Two states have had to make dangerous curtailment of budgets for education and other urgent purposes because almost 80 per cent of the income is earmarked for old-age pensions. What is needed is personal, not political, attitudes and a decent interest in the needs and rights of old people. This is the essence of true democracy.

May the gods of science bring the labors of physiology, nutritional chemistry, pharmacology, metabolism and humanity to fruition so that old age may become a blessing and not a burden, and may this meeting give inspiration to the effort to stay the ebb-tides of the mind.

THE FOURTH STAGE OF GROWTH

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As the title indicates, this paper takes a somewhat optimistic view of (in Browning's words) "The last of life for which the first was made." This is a companion paper to Dr. Strecker's. Although I shall keep in mind and accept the hazards of aging, I want to point out that the presence of hazards does not sharply demarcate old age from younger years. Hazards—mental, physical, economic—occur from the ages of minus 10 months to 90 plus years.

For convenience, the human cycle may be divided into four parts: from birth to 21 years; from 22 to 45 years; from 46 to 65 years; and a fourth stage from 65 onward. Let us now compare the early three stages with the fourth.

THE STAGES OF HUMAN GROWTH

First stage

A short consideration of the first stage brings out the complexities involved in the idea of maturity. Ordinarily it means the culmination of growth, but it can be used to mean the fulfillment of a stage of growth. The full-term newborn baby may be regarded as a mature embryo. Conventionally, a man or woman of 21 is called mature if he or she has certain attributes, among other things. As these are listed, notice how appropriate they are to the years after 65: the ability to love unselfishly, independence, a sound conscience, an appreciation of time values, reliability, and integrity. Here we have a nice balance of attributes that completes an early post-embryonic stage of growth.

But what have been the hazards? One of the hazards of age is cerebral damage, which is also a hazard of the child *in utero*, at birth, and later from accident and infection. One of the hazards of age is called "setness"—fixed ideas and inability to learn—which is usually contrasted with the child's malleability and impressionability. The child is wax which adults mould to their wishes. But did you ever try to feed a baby some food he doesn't like, or to teach an older boy table manners, or persuade a teenager to dress and behave sensibly or drive a car carefully? Where is the malleability that distinguishes youth from age? The mind of a baby is partly wax, partly granite. Ian Stevenson,[1] pursuing this subject, quotes Whitehead, "The doctrines which best repay critical examination are these which for the longest period have remained unquestioned."

And at the end of this first stage what is "falling in love" but one of the great hazards of life? I turn to Booth Tarkington who in *Gentle Julia* describes Mr. and Mrs. Burgess (a couple happily married for fifty-three years and four months) as they are sitting in a comfortable hammock and rocking chair on their porch; they are watching the agonized pacings of Noble Dill, aged 21, who is desperately,

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[1] American Journal of Psychiatry, August, 1957.

frustratingly, awkwardly in love and self-absorbed, irritable and tormented. Mr. Burgess remarks, "Its a terrible time of life—young love is just a series of mortifications—his state of mind leaves him open to all the things he can't stand It is a *horrible* time of life, Martha." "Yes, it is," she answers placidly, "I'm glad we don't have to go through it again." "But you are only 82 and with a girl like Julia around nobody ought to be sure."

Mrs. Burgess' position is that of Maurice Chevalier. When he was 69 and had been for sixty years on French and American stages he was asked if he wanted to live his life over again, and he said, "No, it is better to be upstairs looking at the things that are happening downstairs."

Second stage

Then another stage comes from about age 22 to age 45. It is founded on the maturity—or lack of it—that at age 22 forms an introduction to life, to work, to marriage and to parenthood. The ambitious man or woman is establishing himself in the race, without much time to think about things not tied in with the immediate matters of the day. Husband and wife make a multitude of immediate adjustments to each other and to the world; they learn what it is to be tired and, therefore, irritable; they learn how hard it is to crowd into one day the important matters of work, rest, play and worship. The wife of a resident who was kept at hospital duties eight hours a day, worked in analysis for an hour, and attended special training sessions four evenings a week, one evening kept her 3 children up to 11 p.m., met her husband at the door and formally introduced herself and the children to him. Another man of 35 saw that if he devoted all his time and energy to his business he could attain the presidency of the company at 45; he succeeded in his objective but lost his wife and children in the process.

This second stage of the human cycle adds experience to the maturity attained at age 21. Some of its physical hazards are ulcers and high blood pressure. On the destructive side, this is the rat-race; constructively, it is a time for dynamic and exciting growth.

Third stage

In the third stage (ages 46 to 65), men and women have in a broad sense found their places, high or low, in business or a profession and in the home, and are either satisfied or dissatisfied. The man carries heavier responsibilities, and if he is not secure he carries heavier worries. In general the third is a more even, more productive continuation of the second stage.

Fourth stage

And then comes the fourth stage, with leisure added to what at 21 was at its best a constructive personality formation, and at 65 was fortified by experience. Preferably with retirement from executive work, comes a chance at consultation, membership on an advisory board, or some position which needs long-range views. There is time to think, to compare, to grow. In a paper by 2 local men,

Linden and Courtney, on *The Human Life Cycle*[2] I find these words: "Late maturity may be called a moral and ethical reaffirmative period; a profound concern for system, order and meaning in human existence; the scope of interest wider; the need to correlate the present with the past to determine the nature of accomplishments, errors, and rediscoveries; and increased interest in the history of human development."

This is Chevalier's "up-stairs." Browning wrote:

> So, still within this life,
> Though lifted o'er its strife,
> Let me discern, compare, pronounce at last,
> "This rage was right i' the main,
> That acquiescence vain;
> The Future I may face now I have proved the Past."

Last March I spent two weeks with 153 residents in a Western Clinic. They said, "The younger men on the staff we find to be opinionated and unyielding; the oldest staff members we find to be open-minded, ready to accept a new idea, to break with convention; they can give and take; they are less rigid." Carlson says "Man now lives long enough to have time to think and to grow."

I sometimes pity those who work in Child Guidance Clinics, as they don't know how things will turn out; but men and women over 65 who can be realistic, can know the outcome in many instances. This spoiled selfish child has become a loving and unselfish wife and mother; that child, treated with coolness by his mother, is a happy successful man. "That rage proved right, that acquiescence vain." This steady and reliable child is a steady and reliable adult. The aged know time values; they usually have known five generations from their grandparents to their grandchildren. Compared to a college student, they know fewer things "that are not so."

The key to all the stages of life is Love, but in the fourth stage love can be less passionate, less restricted, more enduring, and more concerned with the meaning of life.

In this country we face both an increase in leisure time (the four-day week) and an increase in the number of citizens over 65. Let us hope that constructive uses of leisure, developed as more people enter the fourth stage of life, will filter down to younger men and make the gift of leisure a blessing instead of a curse.

[2] American Journal of Psychiatry, June 1953.

MOTIVATION IN THE LATER YEARS OF LIFE

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When is a person old? This is a question of relativity. Montaigne writes that Cato, Jr. believed that eight and forty years of age was ripe and well advanced, considering how few men come unto it. To die of age, Montaigne continues, is a rare, singular and extraordinary death, and so much less natural than others. The problem of old age is an increasing one. There are now more than 20 million people over 60 years of age. It is said that by 1980 more than half our population will be over 45. The admission rate of the aged to our mental hospitals is increasing. It amounts to 20 or 30 per cent of the admissions. This cannot be lightly dismissed. It is often a tragedy, because many aged do not belong in mental hospitals. The increasing percentage of the aged in our population is not only a medical problem but a social and economic one as well. A significant number of these people will be vocationally and industrially shelved and set aside by their families. This will become a political problem. People in this age group in time will form a high percentage of the voters of the country. The triumphs of modern medicine have created new difficulties. The care and treatment of the aged, therefore, is going to become more and more a task for medicine and the general practitioner, as well as for the state and society. Problems of treatment and prevention will require more research. Resources are now often wasted in this group of our population and world competition is becoming so keen that we shall no longer be able to carry useless burdens that with research and ingenuity can be turned into resources.

MENTAL HEALTH IN OLD AGE

Old age is not a disease, it is a process. Aging is a process of decreasing strength, both physically and psychologically. It is a process of increasing limitations. It is also a social condition, involving the attitudes of people, and their culture. In China the elderly formerly were held in reverence. In the United States old people are often a problem. They are not esteemed; they are shelved by industry; they often are not wanted by their children; and they are a trouble to families. Often they are sources of irritation resentment and guilt. They are looked on not infrequently as burdens and a difficult responsibility—extra mouths to feed. Considered as economic and recreational liabilities, they are given only a grudging tolerance and are not held in veneration. It is one of the ironies of science that medicine through its scientific achievements has prolonged the length of life; yet industry, created by science, has decreed that automatically people should be laid on the shelf and withdrawn from activity at an arbitrarily determined age. This is one of the contradictions and schizophrenic aspects of our civilization. We have currents which run at cross purposes.

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Preparation

Age is not something that suddenly appears and then should be arranged for and met. It is not a question of years but of effectiveness. The whole of life should be a preparation for this process. Stresses, frustrations and limitations come throughout life. This is of the substance of life, as much as success, achievement and enjoyment. Successful meeting of all these things is meeting old age in advance. Meeting life effectively with its limitations, inevitabilities and disappointments, is preparation for aging. Meeting the challenge of life courageously, but not necessarily always with success, is a preparation for the later period. People who have met old age gracefully have all through their lives had active interests and curiosity, have carried responsibility, and have cooperated with others. They have contributed, and therefore find a continued welcome from others. Cultivation of the ground is important before the harvest appears.

Personality

Old age is, therefore, not just the flexibility of blood vessels and the vitality of cells. It is a question of the flexibility of personality. What keeps a personality vital? It is one's interests, one's outgoingness, the cultivation of continuous and changing interests. Bertram Russell advised old people not to dwell in the past, but to turn their thoughts to the future—the things that need to be done. One cannot live in one's children's lives. Success in old age is easiest, Russell says, for those who have strong impersonal interests involving appropriate activities. The sharing of interests, participating in activities with others, the discovery of areas of usefulness and cooperation, and the maintenance of good relationships are principles for the preservation of mental health and satisfaction in age as well as in youth.

Montaigne advised work and employment early in life as important for health. Cicero in his dialogue on old age has Cato saying that the unhappy and discontented find every age of life a burden.

Psychology

Bourne[1] concludes that there is no single cause of aging, that aging is a complex phenomenon and that we are still a long way from understanding the mechanism whereby cellular and organismal life rises to a peak and then slowly runs down. For man, psychology is important when physiology fails and when former friends and work are no longer contributing factors in his life. In terms of Freud and psychoanalysis, aging would be a gradual overcoming of the life instinct, or eros, by the death instinct, or thanatos. This, however, leaves us with a rather gloomy point of view. If we think of the creative work that men like Whitehead, Bertram Russell, Gandhi and Schweitzer have accomplished in the latter years of life, we see in contrast many opportunities for challenge and achievement. For instance, Bloodstone learned Greek after he was 70. There is a great deal of misplaced pessimism with regard to aging in our country.

Moving into the realm of psychopathology, I can recall a number of patients who seemed to be hopelessly confused and disturbed and to have reached the end

of the road psychologically. Medication and wholesome regimens helped, but often the psychologic influences seemed more important.

Many conditions in psychiatry which seem irreversible prove to be reversible on further study and with appropriate therapy. Sometimes drugs are helpful, sometimes they are not. One 79-year-old patient was continually thrashing around in bed, and consequently had many bruises. The violent movements involved the left side of her body more than the right, and the arm more than the leg. She complained of pain in her head and in her shoulder. Restlessness and confusion were the outstanding features. She did not know the day of the week, the year, or what hospital she was in, and she thought she was 40 years of age. She did not appear to be afraid, depressed, irritable or suspicious. The condition seemed to be one of hemiballismus with arteriosclerotic brain disease—apparently terminal. However, following several weeks of chlorpromazine (Thorazine) therapy and careful nursing, she recovered, returned home, and lived with a companion for five years before she died. Chlorpromazine quieted her and made possible discussions about her life situation, relations with relatives (which were very distressing to her), anxieties, resentments and fears. Problems of living were worked out. After the sharing and togetherness with the psychiatrist she no longer felt alone. This fostered a feeling of security and, finally, courage to tackle life again on her own. In this case, a combination of psychology and medication aided the return to health in a situation involving great distress and a very difficult family situation.

Motivations

People have certain basic motivations. Motivations may be thought of as drives, urges, needs or purposes that move us. They may be based on tissue needs such as hunger and thirst, or on social needs such as respect for work and achievement, or on ideals of devotion and service. Motivations thus have many bases, whether physiologic, personal, psychologic, social, ideal or religious. In helping people medically, all these areas of motivation must be considered. Beyond the physiologic motivations are certain basic psychologic needs. As the sociologist Thomas wrote years ago, they are the needs for change, for security, for respect, and for human responsiveness. A certain amount of change is essential in order to relieve monotony. A certain minimal security is necessary as a base on which to operate. The interest and respect of others is vital. Responsiveness from another human being has great healing value.

Many of the 3000 people per day in the United States who become over 65 are unprepared for what science has given them—longer life and better health. They need a place to live, something to do within their capabilities, and someone to value and respect them. They need places to go to, so that they are not cooped up and restricted. They need to feel welcomed, wanted and useful. These needs do not stop at 60 or 65 years of age.

Principles of mental health

The people I have known who have grown old gracefully have had these opportunities; they have developed resources within themselves. Out of benevo-

lence, kindliness and sharing interests with others in the past, they prepared a welcome for themselves for the future. It was not something that happened suddenly.

The cultivation of wholesome personalities long before old age set in is important. Old age is a gradual thing and all are preparing for it even when young. It is not just a question of chronologic age, and the condition of the arteries and brain cells.

Mental health is the ability to meet problems, to accomplish daily tasks, to take responsibilities without pushing them off onto others—all without undue dependency, unless one is ill. In mental health one is able to contribute to the well-being of others, and carry on activities with a minimum of complaints or disturbances. Interest is a form of outgoingness, a sign of growth and of love; in this sense it is creative. Loving something interesting, or loving something beyond oneself, even if it is a garden or flower or birds, is healthy.

People need to express themselves. They can do this by way of work, love, learning, play, wonder, and worship. Many people find help in prayer. Man has matured technologically, materially, scientifically and physiologically and yet he is often a child psychologically and spiritually. Available knowledge is not lacking in this world of ours, but wisdom is, and so are maturity and the principles of mental health. We can all learn the healing value of human interest in another being. We can all give the relief that comes to another from talking things out. We can help and learn the constructive results of discussion. We can offer another human being in psychologic distress the support that comes from togetherness and an understanding responsiveness.

Julietta Arthur has outlined a Bill of Rights for the Aged:

1. Opportunity to continue to be useful.
2. Opportunity for employment based on merit.
3. Freedom from want.
4. Fair share of the community's recreational, educational and medical resources.
5. Housing suited to needs.
6. Support by the family to the extent that is reasonably possible.
7. Opportunity to live independently, as one chooses.
8. Respect of the community based on service to it.
9. Right to live with dignity, free of outmoded concepts on the proper role of old people.
10. Access to knowledge on how to make later years happy ones.

The community can see to it that the rights of the aged are increasingly met. Older people can help themselves, too. They can meet the closing years and death without fear, as Bertram Russell thinks, "if interests are gradually made wider and more impersonal, until bit by bit . . . life becomes merged in the universal life."

Physiologic factors

Anatomic, physiologic and biochemical factors of importance in old age are: alteration of the cell membranes, difference in viscosity between old and young

cells, increased viscosity of the blood, increased protein concentration at the surfaces of cells, the decrease in esterolytic enzymes, vitamin C, adenosine triphosphate and water content, the increase in plasma cholesterol concentration, the break-up of mitochondria into rods and granules (so-called death granules), the decrease in nerve cells in certain ganglia, the occurrence of argentophil debris, senile plaques, gliosis, amyloid bodies, perivascular demyelinization, and the passage of nucleic acid from bacteriophage into bacterial cells. Recent work has demonstrated the prevention of cell degeneration by free or conjugated nucleic acid in cells grown on embryo extract, the rejuvenation of cells, and the incorporation of desoxyribose nucleic acid into the nuclei of daughter cells. However, it is not clear which of these changes are inherent in the cells or which are due to the lack of external influences.

COMMENT

The aging population represents a challenge—physiologically, chemically and psychologically. Our knowledge of the physiology and chemistry of the nervous system leaves much to be desired. We have indicated some of the needs and motivations of older people. The aging population can be helped, and many of them can be maintained as resources rather than burdens.

It was said in the London Times for October 10 that the scientists of the world are trying to decipher the signal of the Soviet satellite. Mr. Selwyn Lloyd has said the signal is simple: I am the product of Soviet technology, I am the product of Soviet education. . . . Wake up and bring your technological education up-to-date. Kapitza in Russia met the challenge of the satellite. We men in medicine and psychiatry have a challenge in the increasing numbers of our aging population, and we believe this can be met. There are undreamed of opportunities for achievement through research on the physiologic and chemical alterations induced by drugs or electroshock; the manipulation of the environment, both physical and social; and the subtle influences of interactions in personal relationships, or psychotherapy.

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PROBLEMS OF RETIREMENT

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The meaning of the word "retirement" as it is used here—namely, as retirement from occupation—is familiar to all of us. We probably share, in varying degrees, the often-expressed discontentment with it as a term, because of its exclusively negative implications. To date, however, it seems that none of us has been able to propose one that can be agreed upon as better. Perhaps, inasmuch as our language is still a living one, we can by our attitudes and actions over future years help the word acquire some positive meanings.

In this presentation, we shall concentrate our attention upon the problems of the *individual person* who has retired—and only upon those of his problems which result from or are aggravated by the discontinuance of his work. Although admitting that he is a whole person whose problems interact, we shall omit discussion of those problems which he may have but which do not stem from retirement—such as the effects of aging per se upon his health, or of the loss of loved ones by death.

The problems that a man faces as a result of retirement depend entirely upon what his "income" from his work has been, how much of it he continues to need, and how effectively he can find other sources of it. "Income," as used here in quotes, refers to far more than his salary.

A man's "income" from his work depends upon what the work means to him. What his work means to him, in turn, depends upon innumerable things, principally upon what *it* is and upon what *he* is. The latter depends on his heredity and the sum total of his environment and experiences. Thus, it is no wonder that the literature on this subject does not contain the impressive, carefully controlled research that we should like to see. The difficulty of trying to accomplish such research in the face of so many uncontrollable variables is self-evident. This probably accounts, too, for the fact that only the very young, and the uninitiated in this field, have clearly in their minds right and wrong answers to the problems of retirement.

What might a man's work mean to him? To one man, it might mean amazingly little—perhaps, as far as he can tell us, nothing in a positive sense more than a source of financial income. But to another, it might have surprisingly many and important meanings. He may appreciate, for example, that his work fills his time in an inherently interesting manner; he may recognize the satisfaction he derives from the opportunity it allows him to express himself creatively and at the same time to help others. His associations with his fellow-workers, or his

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contacts with other persons in the course of his work, may be more satisfying to him as "income" than the money he gains. His work may be his principal source of self-respect, and of the prestige he enjoys amongst others. He may believe—with considerable accuracy—that his work has a favorable effect on his physical fitness, and that it is the source of most of the mental exercise that he feels has kept him alert and mentally capable.

Usually, the man who thinks of his work as little or nothing more than a source of money will have fewer problems due to retirement, in contrast with the man who thinks of his work in broader terms. However, as Friedmann, Havighurst and others (1) have pointed out, this is not necessarily so. Even assuming equal financial ability to afford retirement, men for whom work has multiple important meanings may and often do welcome retirement, whereas others for whom it seems no more than a source of income do not wish to retire. More often than not, work means less and retirement seems more welcome to men of lower skill and socio-economic levels, and work means more and retirement seems less welcome to men of higher skill and socio-economic levels. But there are many exceptions. For example, the man to whom work means many important things may have great flexibility and individual capacity for adjustment, and may therefore have little difficulty in finding a good number of sources of satisfaction in retirement to substitute for those formerly coming from his work.

HEALTH

In discussing some of the more common things that a man's work may mean to him, without at all pretending we can place them in any order of importance or that our list is complete, let us start with the matter of health.

We have heard that people who retire fail in health and die sooner than they would be expected to if they continued to work. Each of us has undoubtedly seen one or more instances in which this seemed to occur—a man we thought of as healthy retires, and distressingly soon afterwards is buried. But what are the facts?

Morbidity

Unfortunately, we do not have data on morbidity amongst our annuitants which we can compare with data on morbidity amongst our active employees of the same age. A questionnaire survey (2) of a relatively small group of annuitants of a company affiliated with ours revealed no evidence of excessive morbidity. A similar questionnaire survey (3) completed by 218 annuitants of one of our affiliated companies and four other oil companies in the same geographic area revealed that 65 per cent felt their health was better after retirement than it had been before, and 13 per cent the converse.

Mortality

However, we do have information about mortality amongst our annuitants, and can compare this with more general experience and with that amongst our employees.

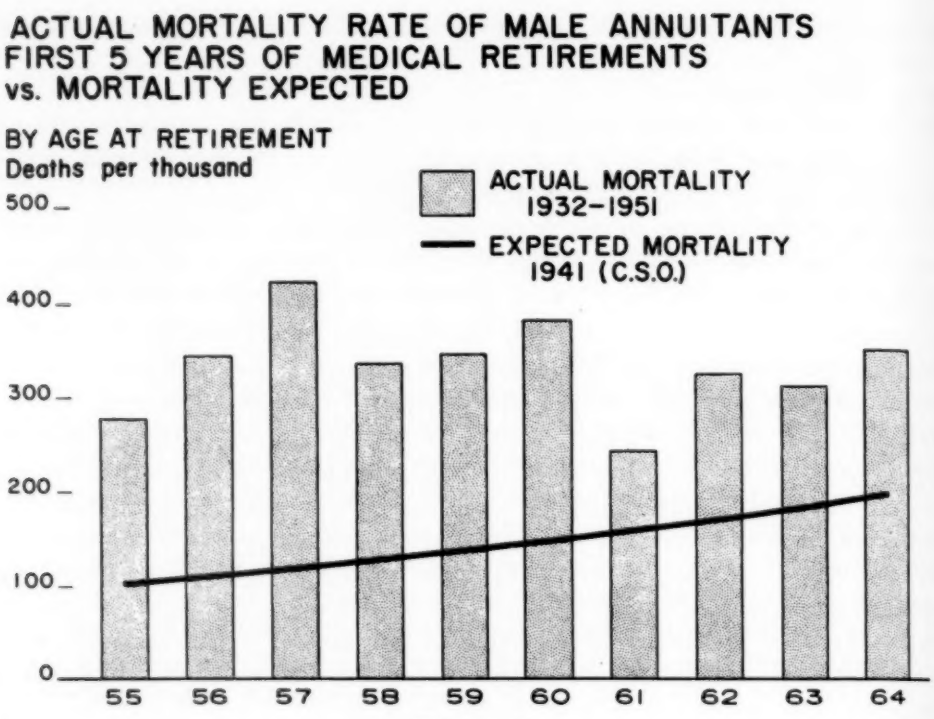

FIGURE 1

In a group of persons retiring because of medical disability, we must expect what actually occurs, namely, a greater mortality rate in the period shortly after retirement than normally expected in the age group. We are dealing here with a group selected on the very basis of a health problem. But surprising as it seems, some of the data that have been used to suggest that there is a higher-than-normal mortality in those just retired, were obtained by the study of groups from which those retiring *because* of disability were not excluded. Myers (4) has cautioned about the interpretation of data on mortality in retirement.

Our experience with respect to mortality amongst retired persons is here summarized in a series of 6 figures. The groups studied were not large enough to allow firm conclusions, and the controls were not all that could be desired. Nevertheless, the following figures[1] furnish a picture of the mortality among 6,624 male annuitants who retired on the basis of service, from our company and a group of affiliated companies between 1932 and 1951; and among 1,912 who retired over the same period from the same companies because of medical disability. The number of women retired is not sufficiently large to justify reporting. The relatively high ratio of medical disability retirements to service retirements may be explained by a common problem—nonexistence of alternate assignments or vacancies for those who, although not totally and permanently disabled for all employment, are incapacitated for their particular jobs.

[1] The data from which these figures were made were very kindly prepared for me by Mr. G. F. Milliman of our company's Insurance and Social Security Department.

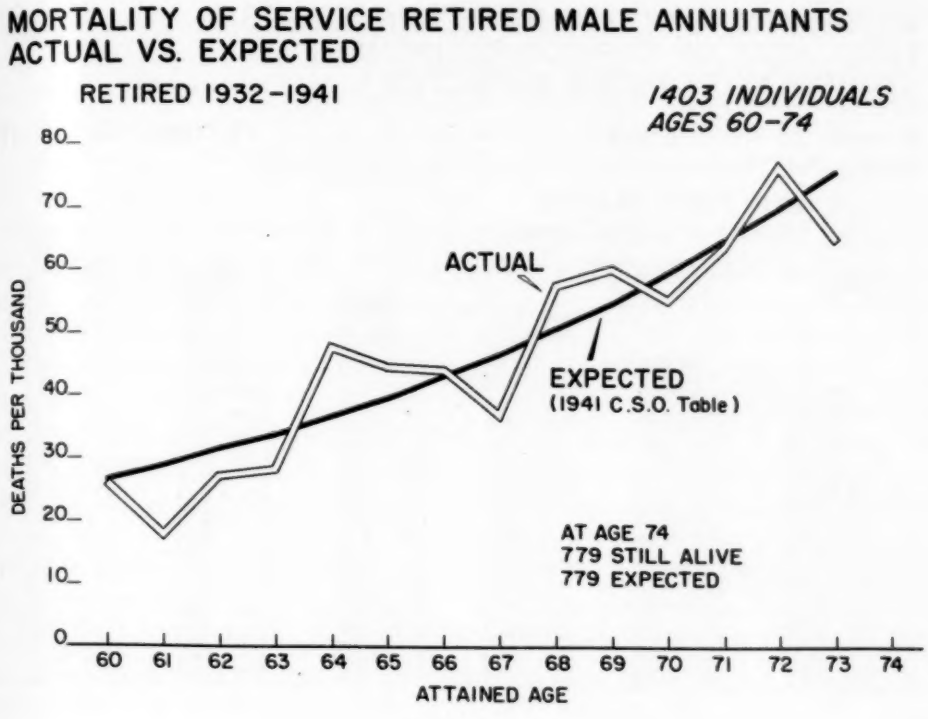

FIGURE 2

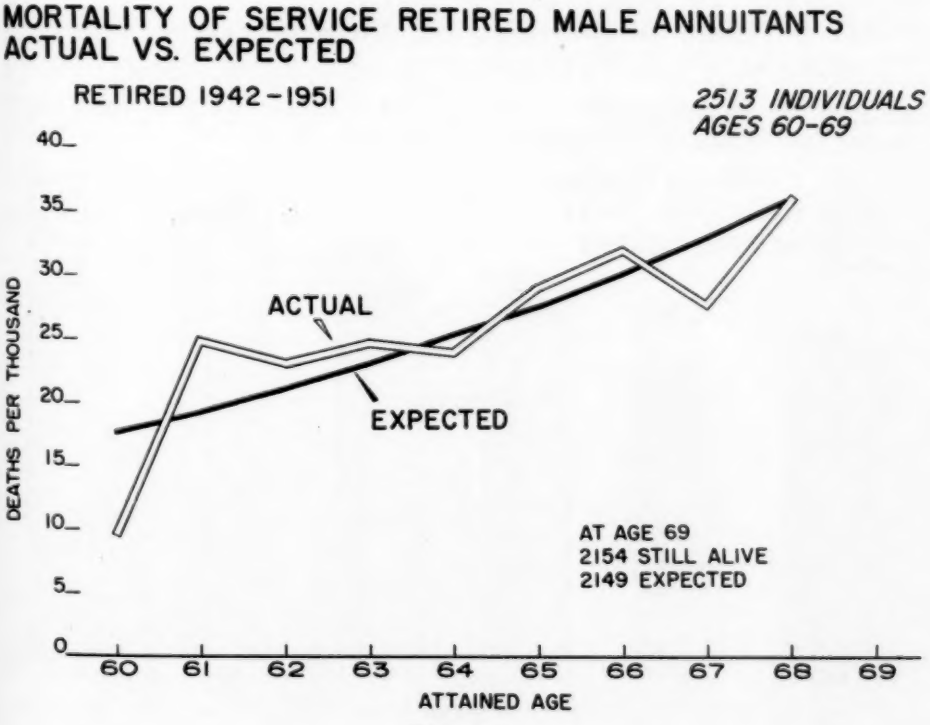

FIGURE 3

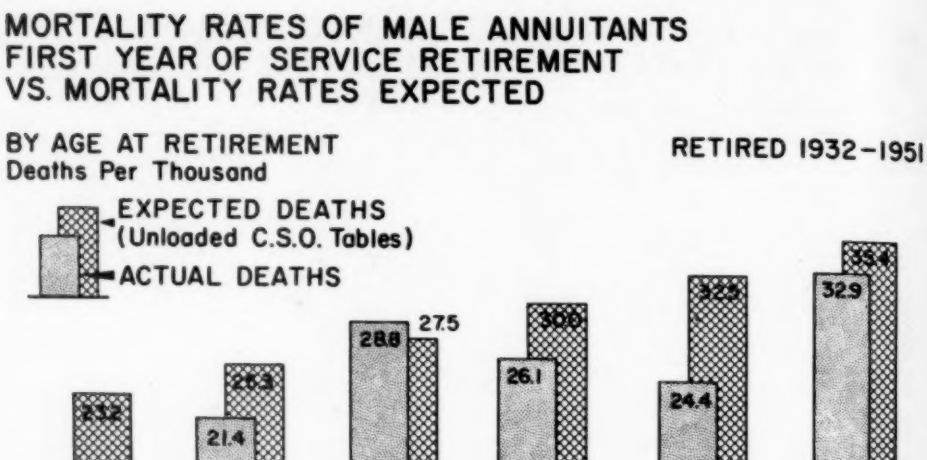

FIGURE 4

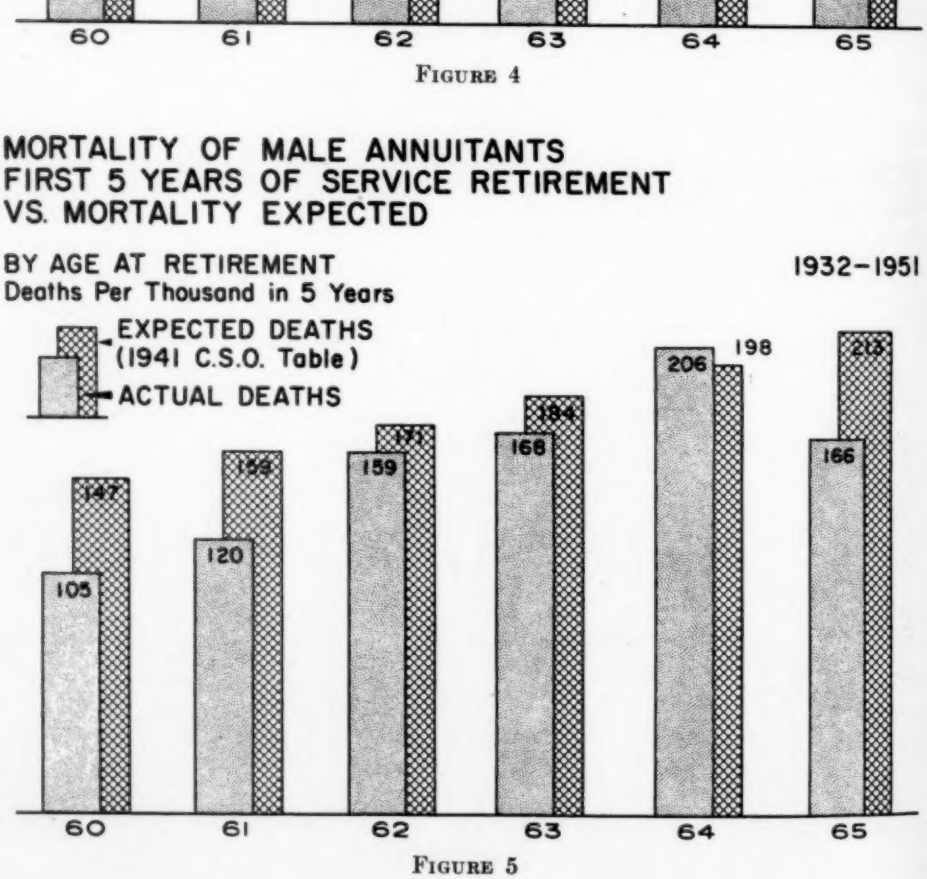

FIGURE 5

Figure 1 demonstrates that in our experience men who are retired due to medical disability *do* suffer a greater mortality than would be expected for their age group in the first five years following retirement. As pointed out, this would seem inevitable in view of our policy of retiring for medical disability *only* employees who are felt by our staff physicians to be no longer able to do their jobs in the company.

On the other hand, Figures 2 and 3, representing the experience amongst a total of 3,916 men who retired between 1932 and 1951 because of service rather than disability, reveal a different picture. There is no evidence of undue mortality. These employees retired either because they reached the age at which retirement is compulsory (65 for those working in the United States, 60 for those overseas), or elected to retire earlier. None was retired on the basis of medical disability. It should be pointed out, however, that some individuals who elect retirement before it is compulsory seem to do so because of a health problem—either one not severe enough to justify a medical disability retirement, or one about which we do not know.

Interestingly (as indicated in Figure 2) 779 of the 1,403 men retiring between 1932 and 1941 lived through their seventy-third year of life. Using the 1941 Commissioners Standard Ordinary (C.S.O.) Mortality Table, based on the standard ordinary experience of life insurance companies during the period of 1930 to 1940, we would expect exactly 779 to live that long.

Experience with respect to the 2,513 men retiring between 1942 and 1951,

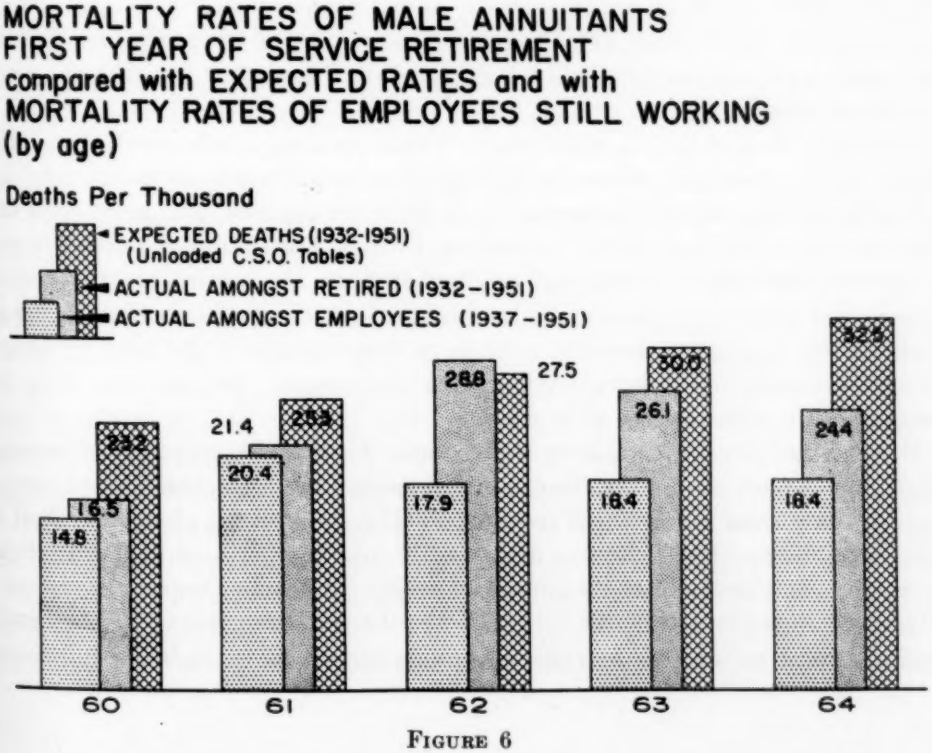

FIGURE 6

shown in Figure 3, was essentially the same as with the smaller number retiring in the previous decade. Of the group, 2,149 would be expected to live through their sixty-eighth year, and 2,154 did. In Figure 3, expected mortality is indicated according to the later X17 Mortality Table based on standard ordinary experience of life insurance companies during the period of 1950 and 1954.

Figure 4 shows the experienced mortality of male annuitants during the first year of service retirement, and Figure 5 during the first five years, compared with the expected mortality for various ages according to the 1945 C.S.O. Mortality Table.

In Figure 6, the mortality amongst those who retired prior to the age of 65 is compared with that amongst those of their fellow-employees of comparable ages who continued to work, and compared with expected mortality rates according to the 1941 C.S.O. Mortality Table. One factor influencing the difference in experience between annuitants and those still employed may be the previously mentioned tendency for those who feel less fit to elect premature retirement.

It is our impression that there is no evidence in the experience recorded here, and we know of none elsewhere, of excessive mortality in the immediate post-retirement period amongst groups from which those who retired due to or with disability have been excluded.

Emotional health

With respect to emotional health, we are taught that there are certain basic needs which must be satisfied if we are to enjoy it—needs such as for love, security, and a sense of self-expression, of achievement and of recognition and approval. If a man's work helps to satisfy some of these needs for him, he must find other sources of satisfaction when he retires if he is not to suffer the consequences of their loss.

Although we say that a man's basic needs continue unchanged after retirement, we must remain aware of the fact that such needs seem to vary considerably in their relative importance in different persons, and may even vary considerably in the same person at different times. For example, most of us seem to need in high degree a feeling of accomplishment, but a fair number of retired men seem content and emotionally healthy doing nothing of a productive nature. Perhaps this is because they feel they have done enough in the past, or because society sanctions nonproductivity during retirement. Maybe, too, they just haven't heard what *we* say they need.

If we define physical fitness as the capacity for intense or sustained muscular effort, we cannot doubt the decrease that occurs in those who do not exercise after retiring from work which required it. The importance of this we shall not debate. However, Bortz (5) has emphasized that the perils of disuse are risked by the mind as well as by the muscles. Roessle (6) of our company expresses it: "The aged lose what they do not use." Are these men correct in saying that for mental fitness we need to stretch our minds just as we stretch our muscles for

physical fitness? We may doubt that they have controlled experimental data to support this suggestion, but on the basis of our experience, most of us would probably agree with them.

Preparation for retirement

Before leaving the area of health, it would be in order to comment upon our medical staff's role in helping to prepare employees for retirement. This is a long-term counseling and health maintenance approach integrated with, rather than distinct from, our regular programs for health education and health maintenance. From the date of employment these services are offered to employees, and the medical counsel and examinations they receive even as young workers are designed to teach them how to remain healthy after retirement, as well as before. We do not conduct group counseling, but with this exception our own program is largely the same as that of Esso Standard Oil Company employees, described by Wade in 1953 (7). Incidentally, although we are disappointed to have to report that at the most only about 60 per cent of our annuitants continue to seek periodic health maintenance examinations from their personal physicians after retirement, this figure still is probably higher than that for persons not indocrinated regarding the value of such examinations during their employment experience and by their pre-retirement medical counseling. Unfortunately, too, many of our annuitants who seek these examinations describe difficulty in finding physicians who seem interested in performing them.

FINANCIAL INCOME

Reduced financial income, in our experience and in much of the recorded experience of others, seems the most common problem of retirement. As would be expected, it is not equally common amongst those of higher skilled and socio-economic levels, although even here it is not as uncommon as one might expect. For the majority of retired people, the squeeze between a limited, fixed income and rising costs constitutes the major and very often the only apparent problem of retirement.

Although the annuities available to our company's employees are relatively generous, and although our employees are able to continue much of their hospitalization and medical-care insurance, we fully appreciate that too many retired people in our country, although able to purchase basic food and shelter, have not enough money left to buy other essentials, such as clothing and drugs. All too often, they are unable to obtain or to afford hospitalization and medical-care insurance at the time of life when they need it most.

We cannot here discuss in any detail this problem of reduced income. Undoubtedly, its eventual solution will depend upon the development of a sound, economic way for a greater part of a worker's compensation to be saved for, and paid to him following his retirement—with at least a portion of such deferred income protected against inflation. A few companies have recently increased

payments to their former employees who were retired some time ago with fixed annuities based on then prevalent wages and living costs.

A number of men who retire from our company continue to work either part-time or full-time, usually to obtain the income they feel they need. Some, incidentally, give the need for additional financial income as their only reason for working, whereas actually this seems to be but a small portion of their motivation.

OTHER ADJUSTMENTS TO RETIREMENT

There are a number of additional and interrelated problems of retirement, such as filling the time formerly used in working, and replacing the satisfactions derived from associations at work and from a sense of accomplishment.

The extent to which these things will be a problem depends on the meaning of the man's job to him, and then upon his energy, resourcefulness and adaptability. If he can turn to others for the associations he no longer has as a result of his work, and if he has other interests with which he can fill his time and remain active and from which he can get a sense of accomplishment, it is unlikely he will have lasting difficulty with these problems. If he is the type of man who can do these things, he probably will succeed in their accomplishment whether or not he plans in any organized way for his retirement. If he is this type of man, he probably has been such for a long time—with many, and usually diverse, extra-work interests and activities. He learned early to direct his attention outward, and to keep his scope broad.

But what if our man isn't this sort? What if he seems truly unable to meet these needs of his, except through work? Can he be prepared adequately for retirement?

In our opinion, he can probably be helped appreciably. Most of our employees seem to profit in varying degrees from either group or individual pre-retirement guidance given sufficiently far in advance by capable and inspiring counselors. Some, admittedly, do not. But certainly most seem to appreciate, and to have profited from, the practical information given them about such things as their retirement benefits, insurance matters, the maintenance of their health, and the potential hazards of too-drastic changes such as in the location of their residence or in the nature of their activities.

Unfortunately, to date we have not enjoyed much success in trying to help employees who are depending too exclusively upon their work for their needs and satisfactions. But we feel that, even if we do not suceed in stimulating these persons to find non-work sources of satisfaction, and must advise them to seek other employment after their retirement from our company, the mere planning that they can sometimes be persuaded to do helps carry them over the difficult period of transition.

Often the best, or even the only course for such men is to find part-time or full-time employment doing something they like, and preferably something

thing with which they are familiar. Admittedly, the labor-supply situation and other well-known problems may make it difficult for them to obtain such employment, but we are impressed with the success that most of our annuitants have in locating suitable work if they sincerely desire and seek it. Often, the annuitant who complains that he cannot find work reveals the superficiality of his interest in doing so by never having really tried to, or by having declined many offered opportunities for reasons not always consistent with the expressed intensity of his desires.

What might have been done earlier to prevent a man's having such difficulty in adjusting to retirement? How early should training for retirement begin? Probably as early as a child's appetite for knowledge and activity seems to provide him with the incentive to develop active interests. His parents' example, assistance and support ought to encourage him in such interests, and ought to supplement what can be done in formal educational programs to promote his maturing into a mentally healthy and responsible adult. He must learn that he cannot live as an island unto himself. He must learn, as pointed out by Allen and Clow (8), that interpersonal relationships are inevitable throughout modern life; and that to have a life within and a life without that are in emotional harmony requires an adjusting to his own emotional needs and at the same time adjusting to the desires, interests, needs and activities of others; indeed, he must develop and preserve more interest in his environment than in himself.

The physician in private practice who has an interest in helping to prepare his working patients for retirement can, with only modest effort, make some observations about the extent to which they depend on their work long before their prospective retirement. If he recognizes a need for greater breadth of interests and activities, and for planning, he can counsel the patient to this effect, and possibly help to stimulate the indicated adjustments.

No reference has been made thus far in this discussion to the spiritual aspect of a man's development and health. It is apparent that religious faith and practices are sources of happiness, and at times of consolation, to many in facing the problems of life—whether these be due to retirement or not. The preliminary report of the fascinating and extensive Cornell Research on Retirement (9), although it indicates that those who are religious seem more likely than the non-religious to obtain comfort and satisfaction from their work and to worry less, does seem to suggest that there is less acceptance of the prospect or concept of retirement by the very religious. However, the latter observation seems to have been based upon attitudes toward prospective retirement, or about the concept of retirement, rather than upon experience and adjustment after retirement of the groups studied.

A further potential relief for those unable to adjust to retirement would be an increase in flexible retirement programs with provisions to allow continued employment for persons wishing and able to remain at work. These programs still seem to be fraught with so many administrative difficulties in satisfying

both the employee and the employer, that even many who advocate them eventually are not urging their adoption now. In theory, retirement on the basis of biologic and mental aging is much more appealing, logical and economical than compulsory retirement on the basis of chronologic aging. Nevertheless, until we are better able to measure objectively an individual's biologic age, his physical and mental fitness to continue to work, and his capacity to perform his work to his employer's satisfaction, the adoption of such programs seems likely to be limited.

In the meantime, we must not fail to appreciate that compulsory retirement at a fixed chronologic age does offer some advantages to employees. Those who work through a career in a company facing a definite retirement date often seem to adjust to it and prepare for it, better than those who do not. In our group of companies, almost 1 in every 2 employees retiring on the basis of service elects to do so before required to, even when this means a decrease in the amount of his annuity.

Should the age at which retirement is compulsory—most commonly 65—be changed, for example, to 68? The pressure for such a change increases. There are so many aspects of the question, however, that it would require discussion not practical in this presentation. Evidently, most if not all of the 48 per cent of our employees who elect premature retirement would not be enthusiastic about such a change.

So much is said and written about the problems of retirement that we might easily conclude that few people become adjusted to this state and enjoy it. We believe that the number of persons who have real and lasting problems is not as great as implied. Admittedly, most of our experience has been obtained with a limited and special group, but the reporting of our impression might serve to counterbalance some reports of observations based upon contact with a disproportionately high percentage of people with real retirement problems.

SUMMARY AND CONCLUSIONS

Most retired persons with whom we have had contact have become adjusted to their retirement and are enjoying it.

The most common problems of retirement seem to be the decreased financial income in those of lower skilled and socio-economic levels, and the loss of the sources of satisfaction offered by their work in those of higher skilled and socio-economic levels.

There is no evidence that mortality is any greater than would be expected according to age amongst our annuitants in the five-year period following retirement for other than disability reasons.

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Panel Discussion on Mental Health; Research Conference on Maturing Man, Growth and Aging. (Left to right) Doctors Strecker (Moderator), Bond, Appel and Roberts.

PANEL DISCUSSION ON MENTAL HEALTH

RESEARCH CONFERENCE ON MATURING MAN, GROWTH AND AGING

Moderator: EDWARD A. STRECKER, M.D., Professor Emeritus of Psychiatry, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania.

Panelists: NORBERT J. ROBERTS, M.D., Department of Occupational Medicine, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania; Associate Medical Director, Standard Oil Company (N. J.), New York, N. Y.; EARL D. BOND, M.D., Professor Emeritus of Psychiatry, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania; KENNETH E. APPEL, M.D., Professor of Psychiatry and Chairman of Department, University of Pennsylvania School of Medicine, Philadelphia, Pennsylvania.

DR. STRECKER: While we are waiting for questions to be passed up from the floor, I suggest that each member of the Panel ask another member an unrehearsed question. I shall begin by asking Dr. Roberts whether he has any ideas—I don't think any statistics are available—on the attitudes and roles of wives of retired employees.

DR. ROBERTS: Thank you. You're right in that I have no statistics, but I have some convictions. We could talk at great length about the problems precipitated for a wife by retirement. There is a positive correlation between a wife's attitude and her husband's happiness in retirement. A man who says "My wife isn't happy about my retirement" is seldom himself happy. Although I don't have any suggestions about how we could influence this situation, I am amused by the number of retired men who are doing work for their wives but are ashamed to admit it. They tell me—after I assure them I won't write it down—that a good part of their day is spent doing housework.

DR. STRECKER: But what is the general attitude of wives about their husband's retiring?

DR. ROBERTS: I would guess that more wives than not are pleased to have their husbands retired. The wives who are unhappy with husbands underfoot are the exception. It is hard to tell whether the wife's unhappiness results from the husband's unhappiness or vice versa, but the husband's attitude may be the more fundamental.

DR. STRECKER: Now I shall ask Dr. Bond to ask some member of the panel a question.

DR. BOND: I have in mind the situation of a doctor retiring from executive work or from a hard and confining general practice to some kind of consultative work, or a business executive who retires to a semi-active place on the Board. I should like to ask Dr. Roberts what there is in a man's daily work over twenty years that he can take with him into retirement?

DR. ROBERTS: Very, very few people are offered consultative positions by industry when they retire, and these offers naturally are more often made to men in top executive positions. A great many of our retired people have a tend-

Doctors Strecker (Moderator), Bond, Appel and Roberts

ency to take up something that makes use of their interests and what they have learned in the course of their work. Many people in mechanical trades, for example, continue such work as a hobby or on a part-time basis, either as a source of satisfaction or of income. Many executives set up consultation practices on a private basis, and lawyers often seem to become consultants after retirement from corporate law work.

DR. STRECKER: Thank you, Dr. Roberts. Now, Dr. Appel, will you pose a question to one of us?

DR. APPEL: I am sorry to be pressing Dr. Roberts, but I was going to ask whether you are familiar with any studies which provide periodic psychologic testing and physical examination and indicate any change in capacity to perform as the decades roll by?

DR. ROBERTS: I cannot list any such studies offhand. Many of the people here are probably far more familar with them than I. The flexible retirement concept necessitates tests for determining physical and psychologic fitness for continued work. Some of these have been proposed and we all know of certain ones that may well be valid in our own area of special interest. I suspect that on a few moments' notice you could propose some questions that, if answered honestly, would give you at least some estimate of a man's flexibility or, let us say, of his tolerance of ambiguity. If we accept the concept that intolerance of ambiguity is an undesirable characteristic of aging, and that it would be undesirable in certain types of work, then we would be making at least a little progress in measuring a man's psychologic fitness to continue such work. Studies of this sort have been carried out, but I cannot comment on their quantity or validity. This is one of the goals here at Lankenau. Those of us who are enthusiastic about flexible retirement on the basis of biologic and mental aging are anxious for progress in this area.

DR. STRECKER: I'm afraid your services are not yet dispensed with, Dr. Roberts. The first question from the audience is for you, and I think you have partially answered it but may want to amplify. It is headed "compulsory versus voluntary retirement." Research has shown that many people who retire voluntarily are more likely to be well adjusted than those who do not accept retirement. Have you any further remarks on compulsory versus voluntary retirement? You have largely answered the question on the somatic side.

DR. ROBERTS: The question contains the implication—correct, I think—that people who retire voluntarily are more likely to be well adjusted. I suspect that they most often remain so adjusted. When we measure the contentment of those who retire involuntarily we find a significant increase in adjustment as time goes on. Perhaps 60 per cent of them will be distinctly unhappy one year after they retire, but only 35 per cent after two years. Of course, some people will persist in being unhappy.

DR. STRECKER: The next is a simple question addressed to Dr. Bond: "How do you define emotional maturity?"

DR. BOND: That's a thing that goes along with "How do you define normality?" I've been working for about fifty years on the subject, and we can

almost define normality as enough emotional maturity for the chronologic age. I don't think it can be established, or ever will be, exactly what either normality or maturity means; but maturity does mean possessing at a certain age the things that go along with that age. A six-month-old baby has no conception of time, whereas the mature person must have a way of estimating past, present and future and considering the items that belong to the different times. Whereas the baby is utterly dependent, the mature person must be independent to a degree consistent with chronologic age. At 50 he ought to have the emotions of a person of 50, but we can never say those emotions must be specifically this or that. We have many one-sided people who are very mature at 50, and many who have not reached maturity. It is easy to detect when a person is immature at a certain age. Rarely, some men in high office have been known to throw themselves on the floor in a tantrum when their recommendations were thwarted; at that moment the emotional age was 4 years. To put the matter in positive terms—"What's the ideal matured emotional development of a man or woman?" That's a question I'd like to have someone answer for me.

DR. STRECKER: This is really a question that should be answered by a group of psychiatrists. Dr. Appel's concept of maturity is the one that was adopted at the United Nations Conference. I once began by looking the word up in Webster's Dictionary and received this enlightenment: "Maturity is the state of being mature." Perhaps Dr. Appel can add a little to that.

DR. APPEL: This goes along with the question Dr. Steedkins posed to me. He should be answering it, because he knows a lot more about these things than I do. He said "What about a Bill of Responsibilities?" I had spoken of a Bill of Rights for people growing older and he proposed the Bill of Responsibilities. I think that goes along with the concept of maturity. A person who is mature takes responsibility, meets problems and takes risks; he may fail, but he doesn't hesitate to tackle problems that seem reasonable. He is independent but not too independent. He contributes to the welfare of others. Giving and taking are in good proportion; that is, his life isn't all taking. There is great emphasis in our culture on taking and getting, all buttoned up on contributing. That is a problem for education, for religion, and for the psychiatrists. It's a problem of mental health, so we are quite correct in saying that a Bill of Responsibilities should be included in our education. It would help in assessing the matter of maturity.

DR. STRECKER: I should like to emphasize what Dr. Appel has said. A very important part of the concept of emotional maturity lies in attaining the ability to work with other people and to get along with them. With respect to normality, I remember when I was a cub member of the staff at Pennsylvania Hospital; in about three weeks I understood all about psychiatry, with only one question remaining unanswered. I went to the Superintendent, a very practical man, and said "I think I have all the answers but don't quite understand what being normal means."He looked at me and said "My son, I think it's the ability to keep out of a mental hospital." Perhaps maturity is the ability to keep on getting along with other people.

DR. ROBERTS: Dr. Strecker, may I ask my single question? Do you have any

special suggestions as to what we should be doing or doing better to help our children mature into responsible people? What are we failing to do—what are we not doing well enough?

Dr. STRECKER: I would put that the other way—What can we do? It seems to me that if the parents would look back into their own lives and pick one thing which they felt in its aftermath was a handicap to them in adult life, and resolve that that particular thing would not be inflicted on their children, then in a few generations we should do much better and be in a happier world. Of course, what we do is governed by a principle—a give-and-take principle. Mothers and fathers, particularly mothers, fulfil the first part of the dual function of motherhood usually very well. They want their children. If they don't want them at first they learn to want them. They protect and fondle and pet them—which is splendid. The second part of the dual function is to be willing to emancipate the children, and I think in that there is very sad failure in this respect. In a general way, whenever we fail in preparing children to take the step from childhood into adult life, that failure is going to influence the child's life. Dr. Roberts, we have another question for you. Have there been any polls, any detailed information obtained from a group of happily retired people, in which they list the factors that have made their retirements happy?

Dr. ROBERTS: Yes, there have been a number of such polls, and some good ones. Probably the most fascinating is the one being conducted by Cornell at present; it hasn't been completed. According to most such polls, the workers who had no organized plans for retirement seem to enjoy themselves and to have quite as happy and effective a retirement as those who did considerable planning. There are certain objective correlations. For example, the person who has no children is more likely to be happy after retirement, according to some studies. The person who has many children is also likely to be happy in retirement, but the person who has only 1 child is least likely to be happy. Then there are other factors, such as religion, which seem to be operative only at the extremes. The strong religious convictions of some people help them to be happy in retirement, but those with no religion or with anti-religious attitudes naturally discount the value of such convictions. Other things have been correlated with contentment, such as whether or not people own their own homes. This may reflect many different characteristics, but those who own their homes seem even more happy when retired than those who have no economic problems but do not own homes. The characteristics that lead a man to purchase his home may make it easier for him to be happy in retirement.

Dr. STRECKER: Another question for you. How about reassignment for retirement?

Dr. ROBERTS: I take that to mean continuing an individual in work but simply assigning him to different work. Yes, a number of companies succeed in doing this. I am told that there are at least two dozen major companies in the United States with flexible retirement programs. They offer a person the opportunity to continue in the company if there is work available for which he is physically and mentally fit, even if it isn't in his own area of past experience. They

may, for example, take a man whose work has been primarily intellectual and allow him to remain as a janitor if he chooses to do so. Many of these companies are enthusiastic about their results. It is surprising that a fairly high number of those who choose voluntarily to stay at work after the ordinary retirement age seem to change their minds relatively quickly. They seem not at all inclined to retire at age 65, but a fair percentage of them retire at age 66, and most of the remainder are gone at age 67.

DR. STRECKER: Thank you, Dr. Roberts. I might add a postscript to what I said about the duality of the maternal function. Dr. Bond coined a phrase some years ago which expresses it very aptly. He put advice to parents about their children in five words: "Love them and leave them."

Now we have a question for Dr. Appel. How do you encourage motivation in the elders? I'm anxious to hear this myself.

DR. APPEL: It's hard not to be personal here, because I have lived with 2 people who have been growing old gracefully, and who have active interests. Dr. Bond's book is about to be published, so this is a question I am living with each day, and the answer is obvious. Both these people have inner resources, outgoingness, and interests that are carrying them along. They are exceptional people. The question was how to encourage motivation in the elders? It is possible in talking with people to suggest alternatives of action for elderly people, and I think that is very important. There are a great many people who do not think of things they can do which are useful to other people. I know a person 92 years of age who is glad to go to the library and look up something for me; or do some shopping for me. It is possible to encourage activity for people who perhaps don't have the initiative within themselves. Friends and relatives as well as the doctor can do it; it needn't be a burden. Too often we remain passive and think that ideas will come spontaneously to other people.

DR. STRECKER: Along these lines—there is a doctor in the Midwest (whom I don't know personally), who is quite old and who reads every one of my books for one purpose. He writes me a very nice letter and tells me all the mistakes in them. He is not being critical, but he points out every little misprint. He is really amazing, and each book turns out to have a surprising number of mistakes. If I continue to write books he will have a lifelong occupation. That exhausts the questions from the audience.

CHANGING MAN

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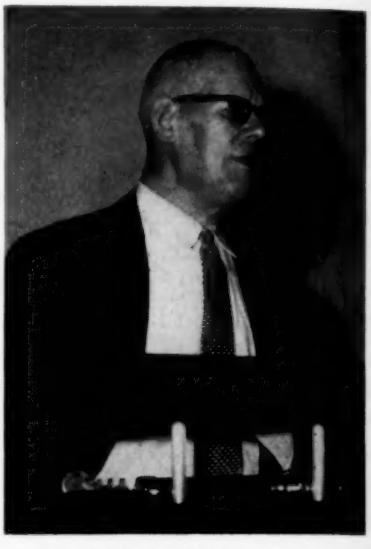
THE CONDITIONS OF CHANGE



DOCTOR KROGMAN

By its very semantics the problem of change is a dynamic one. More, it is multi-directional and time-linked. Certainly, in the past, *Man has been changed* by external forces. Equally certainly, in the future, *Man will change* those same forces. He is both product and producer. How far can he go?

It is important at the outset to recognize that change is only relative; it cannot be absolute. Kind, degree, and amount of change in Nature must be within definable limits. For example, in environmental and physical terms, Simpson (1949) says that the Earth has had the same form and the same structural conditions over the past 2 billion years, whereas Darwin (1956) says that the climate of the Earth has been "fairly stable" for the past billion years. In biologic terms, Mettler (1955) says a basic limitation was imposed in the Paleozoic, *i.e.*, the "necessity of a cell living in an aqueous medium to obtain oxygen and food." Similarly, Huxley (1953) states that long before the end of the Cenozoic "most of the possibilities available to living substance had been exhausted, in one animal group or another." In a sense, therefore, the question of how far Man, as well as life generally, can go is a self-limiting one.

There can be no doubt that Man has been part of all organic evolution—part of what Simpson calls "the unity of life." More, he has been part of what the same author calls the "opportunism" of evolution. Natural selection, working through time, has filled all niches in all habitats. There is no avenue into which organic life has not forayed. There is no form which organic life has not taken or has assayed. There is no sphere into which organic life has not penetrated, from the material or physical to the non-material or spiritual. There have been life processes to fill every need; structure and function to fill every demand. Within its bounds organic life is inherently experimental, potentially and infinitely daring. Man is a link in this organic chain of evolutionary progress. More than that, however, he is answerable to all rules and obedient, in essence, to all integrative factors. Simpson (1950) quotes Cuvier's (1812) law as follows:

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Every organism forms a whole, a single and closed system, all the parts of which are in mutual correspondence and collaborated by reciprocal reaction in the same final action. None of these parts can change without the others changing also, and consequently each of them, taken separately, indicates and gives the other.

In keeping with the basic rules of Nature, organic change has been one of constant biologic improvement, which, operative through time, has resulted in natural selection. The process of improvement has involved constant specialization and detailed adaptations, related either to an adjustment of a part or a system, or a more general adjustment to a new way of life. If these adjustments have been successful, there is advance and there is progress. Advance and progress, with time and over space, lead to adaptive radiation and deployment; there is, quite literally, both forward (upward) and sideward (spreading or branching out) movement. The reward is diversification of form and discontinuity of process, the former leading to the latter. Diversification can go only so far, for here once more is inherent limitation; the very conditions of relative isolation which stimulated the change dictate its selective value. Over-specialization, going too far in adaptive response may easily become non-selective. Extinction is the lot of such an organism.

Where does Man fit into all of this? There can be no doubt that his emergence has been in accordance with the rules of the game: adaptation, specialization, advance, radiation and deployment. There can be no further doubt that he now makes some of the rules. Man, the most adaptive of all animals, now adapts certain selective processes or factors to himself. Childe said "Man makes himself"—he does more: he makes his direction! He has intelligence, he has great flexibility; more than any other form he favors individuality, and he has an extra-organic something called social structure.

Man is, in terms of an evolutionary framework, limited as is all organic life. His change, in its initial direction, was dictated by the adaptive radiation of which he was a part. But Man is more than organic, so purely biologic criteria of change must yield. If so, then Man's potential of change takes a different yardstick of evaluation. That is what we must now measure.

MAN'S MAJOR AVENUE OF CHANGE

Frankly, this sub-heading is out-and-out anthropocentrism. The avenue is infinitely older than Man; he strolled onto it quite late, but he *has* extended its length, and influenced its direction. And the main avenue? A nervous system, leading to a cerebral cortex, culminating and triumphing in a mind. A nervous system goes back to the sea anemones and the nerve-net of the polyps. The cortex has been on its way for a half billion years. Only in a mind may Man claim a real measure of originality, very lately achieved in evolutionary history.

During all this time, specialized improvements have occurred. For example, Huxley (1953) points out that speed of transmission along nerve fibers has increased six hundred-fold, from 6 inches per second in a nerve-net to 100 yards per second in some parts of the human nervous system. Harrison (1956) speaks of "the electrochemical device that has become the human brain," with 100

times 100 million centers of communication, which (in an analogy) "permits automatic dialing" and which, within limits, is self-repairing. In one human brain, he says, there are five times as many pink or gray neurons as there are people in the world, and all of these cells are "all in place four months prior to birth." There is efficiency too, for our brain operates on "much less than 100 watts."

There is no need to belabor the point of cerebral evolution: it is, in its further reaches, unique to Man. The real problem is what he has done with it—or, more likely, what it has done to him. The answer to this problem must take us back in time.

The age of Man, as Homo, is open to question. Recent finds, such as *Oreopithecus* in southern Europe, suggest that hominid traits were in evidence at least 10 million years ago. Mayr (1950) has suggested that the Australopithecine ape-men of South Africa mark the emergence of the genus *Homo*. His classification is as follows: *H. transvaalensis* (including Australopithecus, Paranthropus, and Plesianthropus); *H. erectus* (including Sinanthropus, Pithecanthropus, Soloensis, and (?) Heidelberg); *H. sapiens* (including Neanderthal, Cro-Magnon, and other early sapiens-like forms, as well as modern man). The total time-span represented is of the order of 1 million years or so. The species *sapiens* has an age estimated anywhere from 75,000 to about 150,000 years.

We are now at grips with a basic fact—the lateness of the truly human brain—and a basic problem—the apparent speed of later stages in cerebral evolution. Harrison (1956) says that in 1 million years Man has gone from "20 ounces of brain to three pounds"; again, he avers that the human brain has doubled twice in size "since Man first came to reason." This is, if true, an incredible acceleration. How may we account for it? Simpson (1950) quotes Edinger (1948) as follows:

> Our material shows, however, that in actual, phylogenetic brain evolution there were phases different from the stages of brain evolution existing in living mammals.

It may be, therefore, that the human brain is the result of a saltatorial evolution—possibly, even, a mutationally-directed acceleration.

The actual evidence for the brain-size factor in the Primates (including Man) is as follows (Mettler, 1955; also Washburn, 1950):

Chimpanzee-Gorilla		325–650 cc.
Australopithecines		450–650 cc.
Java Man		750–900 cc.
Pekin Man		900–1225 cc.
Swanscombe		1300 cc.+
Fontechevade		1300 cc.+
Neanderthal		1100–1700 cc.
Cro-Magnon		1550–1900 cc.
Recent	male	1200–1750 cc.
	female	1100–1550 cc.

Actually, this is a rather disconcerting set of data. If size, alone, be a factor in "intelligence" Stone Age men were well in the running! As far as the Ape-Man

dichotomy is concerned, Washburn says that "differences in the brain between apes and man . . . were attained after full human status had been achieved in limbs and trunk." This concept of differential evolutionary rate within a single form may help explain the efflorescence of structure (brain) and function (mind) in Man.

Certainly, for the last 100,000 years or so, brain-mass in Man has not increased.[1] And it probably won't in the next 100,000 years or so, although Simpson (1949) suggests that increase in human intelligence "will give a larger brain" and will make Man more paedomorphic ("making the adult more childlike in proportions," with head large relative to body size and volume). To this "larger brain" idea Mettler points out that there are limiting factors, both obstetrical (head-size) and physiologic (oxygen requirements of the brain). There is really no need to postulate an increase in brain size with cultural evolution, for the latter is really its own impetus.

Quite apart from the brain, per se, we must now consider its import in Man's being. We have inherited cumulative improvements in the nervous system which have resulted in an illusory quality called *mind*, which is an important operative part of the total human mechanism. The brain functions as a neuro-physiologic entity: it runs our bodies; it functions also as a neuro-psychic complex; it runs our lives.

Man's mental organization has resulted in what Huxley has termed two "crucial novelties": *speech*, and the *creation of a common pool of group-organized experience*. "Verbal language," he says, "was perhaps the greatest technical invention of living substance." It has created a new realm of life, the *noösphere*. And this new realm of life has created its own set of problems and its own structure. These we must consider, and in this order. The problems are those inherent in increase in length of life and in numbers of population. The structure is that labelled "society" or "culture."

THE EMERGENCE OF HUMAN LONGEVITY

Twenty-two of the 38 skulls of Pekin Man represented subjects of these ages: 15 were children up to 14 years, 3 were persons between 14 and 30 years, 3 between 40 and 50 years, and 1 between 50 and 60 years. For Java Man skulls, I and II were assessed as belonging to a person 50 (+) years old, and skull III as "juvenile" (Weidenreich, 1939). For later prehistoric Man, Vallois (1937) offers the data shown in Table 1.

In urban Rome of 2000 years ago, life expectancy was about 20 years, but in more rural Lusitania and Hispania it was 35 years for females and 40 years for males, while in North Africa the figures were 50 years and 45 years, respectively.

[1] Mettler (1955) says that there is no evidence that modern man has more neurocytes than Neanderthal and Cro-Magnon. Yet, Coon (1950) makes the questionable statement that "most would, I believe, admit that . . . the recorded changes in the size of the human brain are in some way associated with increases in cultural complexity." This sounds too much like "Kultur schlägt der Schädel breit." We know that brachycephalization and culture do not go together.

TABLE 1

Group	Age (yrs.)					
	0–11	12–20	21–30	31–40	41–50	50+
Neanderthal (20)*	8 40%	3 15%	5 25%	3 15%	1 5%	— —
Cro-Magnon (102)	25 24.5%	10 9.8%	28 27.4%	27 26.5%	11 10.8%	1 1.0%
Mesolithic (65)	20 30.8%	4 6.2%	32 49.3%	6 9.2%	1 1.5%	2 3.0%
	0–14	14–20	21–40	41–60	60+	
Bronze Age of Austria (273)	21 7.9%	46 17.2%	108 39.9%	79 28.6%	19 7.3%	

* The numbers in parentheses refer to size of series.

TABLE 2

0–14 yrs.	14–20 yrs.	21–40 yrs.	41–60 yrs.	60 yrs. +
23 17.0%	23 17.0%	55 39.7%	22 16.3%	18 13.4%

For Egyptians of the Roman Period (first century B.C.) Pearson (1897) reported on 141 crania as shown in Table 2.

For 11–13th century England Todd (1927) studied 143 skeletons, representing a median age of death of 35–39 years. Among living primitive peoples the "peak" in the curve of death is in the 20's or 30's.

It is only when we come to quite recent times that old age becomes a real factor. There are available many data in support of this statement. Table 3 is as representative and meaningful as any (from *Statist. Bull.*, 1956; also *ibid.*, 1957; and Dublin, 1952).

In 1900 A.D. Man might expect to reach not quite 50 years. In 1955 the expectancy for white females was 73.6 years and for white males 67.3 years; for non-whites the figures were 65.9 and 61.2 years, respectively. In 1900–1902, among whites, 24 per cent of males and 21 per cent of females, failed to reach age 20; the figures for failure are now only 3–4 per cent. In 1900–1902 white males reaching 20 years lived to age 65 at the rate of 514 per 1000; in 1955 the rate climbed to 686 per 1000. Since 1900 the number of men living 10 years more after attaining 65 years has increased from 545 per 1000 to 605 per 1000. Today white males who have reached 75 may look to 8.0 years more, and white females to 9.2 years more. Harrison (1956) has summed it up by saying that the increase in longevity in recent decades has been five years in every ten.

If we refer to the foregoing table, a significant differential age-group trend is observable in the past hundred years. The frequency in the "under 5" group has dropped 4 per cent, in the "5–19" group 12.2 per cent, and in the "20–44"

TABLE 3

	Under 5 Yrs.	5–19 Yrs.	20–44 Yrs.	45–64 Yrs.	65+ Yrs.
1850	15.1	37.4	35.1	9.8	2.6
60	15.4	35.8	35.7	10.4	2.7
70	14.3	35.4	35.4	11.9	3.0
80	13.8	34.3	35.9	12.6	3.4
90	12.2	33.9	36.9	13.1	3.9
1900	12.1	32.3	37.8	13.7	4.1
10	11.6	30.4	39.1	14.6	4.3
20	11.0	29.8	38.4	16.1	4.7
30	9.3	29.5	38.3	17.8	5.4
40	8.0	26.4	38.9	19.8	6.9
50	10.7	23.2	37.7	20.3	8.1
55	11.1	25.2	35.0	20.2	8.5

TABLE 4

Nature of Mating			LSM		FHR	
Father		Mother	Abs. Freq.	% Freq.	% Freq.	Abs. Freq.
S	×	S	10	2.7	19.6	28
S	×	A	8	4.9	18.2	3
A	×	S	10			23
S	×	L	31	17.5	9.8	5
L	×	S	33			9
A	×	A	21	5.8	19.6	28
A	×	L	51	23.3	21.0	15
L	×	A	34			15
L	×	L	167	45.8	11.9	17
Totals.....			365	100.0	100.1	143

group 0.1 per cent, whereas in the "45–64" group it has increased 10.4 per cent and in the "65+" group 5.9 per cent. There has been a demonstrable skewness in an upper direction: we are an older, rather than a younger, population. Paradoxically, we are living longer older because we are living better younger. Improved medical care, better hygiene, a more balanced diet, have all combined so that to be born is ipso facto to be well-nigh guaranteed reaching adulthood, and to be vouchsafed the fullness of years in the later decades of life.

There is another factor to be considered, *i.e.*, selection itself, as reflected in human heredity. The evidence is not direct, but implications are clear. For example, we may observe the early study made by Davenport (1934). He set up 3 categories: short-lived (S), either parent dying under 50 years; average-lived (A), either parent dying between 50–69 years; and longlived (L), either parent dying at age 70 years or over. He studied 2 series—long-series mating (LSM), which produced many aged persons; and a random sample (FHR), not selected for longevity. His data are given in Table 4.

In this study, over 86 per cent of the matings which produced octagenarians or better had 1 or more parents in an L category.

These hereditary data are very suggestive, yet they are but one aspect of the whole geriatric problem at the individual level, as Kallmann (1957; also 1956) suggests:

> Since genetic phenomena are the cause of many individual differences in the degree of ageing, it is inadvisable to approach geriatric problems with the preconceived notion that the adjustive difficulties of the aged are more or less the same for all persons and thus conducive to management by stereotyped methods.
> Biological factors advantageous to adjustment to ageing include healthy and longevous parents, the efficacious use of genetic potentialities for physical and mental health throughout life, and the establishment of adequate emotional adjustment before senescence.

Closely linked to the fact of longevity is the question of its limitations. First of all, in the broadest possible sense, must be considered the general organic principle of species boundary. There is an ultimate upper limit peculiar to each form of life. In Man it may well be somewhere between 100–150 years. But beyond that. . . . Secondly, in an equally broad sense, there are 3 types of "foreign invaders" (Harrison, 1956) to which Man, as in the case of other forms of animal life, is vulnerable: 1) the viruses, large protein molecules or groups of molecules; 2) bacteria and molds, single-celled plants; and 3) protozoa, single-celled animals. Here are potential natural barriers.

In the same rather general vein, Pearl (1928) suggests that there is a phylogenetic shift in systemic disease involvements, expressed in terms of structures from the primordial embryonic derivatives. The distribution among the 3 primary germ layers of each 100 organically classified deaths is shown in Table 5.

This is an interesting and significant shift. From Mammals to Man (using the European data) the increase is 10 per cent for ectodermal derivatives, 21.7 per cent for mesodermal derivatives, with a decrease of 31.7 per cent in endodermal derivatives. The shift is in part *to* the nervous and vascular systems, and *from* the digestive system. This is one of the prices of progressive advancement!

Deterrents to old age are basically organic, true—but they are differentially so, as far as Man is concerned. His vulnerability is conditioned by the circumstances of his life. In Table 6 Clements (1931) lists the cause of death among several United States population samples.

The Negro and the Indian have 3 peaks in their curve of death—infancy, adolescence and early maturity, and old age. The Whites have only 2—infancy and old age. Longevity and death are both reflections of cultural level.

TABLE 5

Germ Layer	Reptiles	Birds	Mammals	Man: (São Paulo, 1917)	Man: (Engl. & Wales, 1914)
Ectoderm	0.7	0.1	1.0	7.2	11.0
Mesoderm	7.7	11.6	13.5	28.0	35.2
Endoderm	91.6	88.3	85.5	64.8	53.8
	100.0	100.0	100.0	100.0	100.0

TABLE 6

White	Negro	Indian	U. S. Southwest: Mohave, Chemehuevi
Heart disease	Tuberculosis	Tuberculosis	Tuberculosis
Kidney disease	Heart disease	Pneumonia	Pneumonia
Cancer	Pneumonia	Heart disease	Early infancy
Pneumonia	Kidney disease	Early infancy	Diarrhea, enteritis
Tuberculosis	Cerebral hemorrhage	Kidney disease	Senility
Cerebral hemorrhage	Early infancy	Influenza	Heart disease
Causes in early infancy	Influenza	Diarrhea, enteritis	Cancer

TABLE 7

Area	1650	1750	1800	1850	1900	1950
Europe	100	140	187	266	401	559
Anglo-America	1	1.3	5.7	26	81	166
Latin America	12	11.1	18.9	33	63	162
Oceania and Australia	2	2	2	2	6	13
Africa	100	95	90	95	120	198
Asia	330	479	602	749	937	1302
Totals	545	728.4	905.6	1171	1608	2400

For the U. S. generally (1950 data), Bates (1955) cites a total of 1,452,454 deaths, or 9.6 per 1000. The causes were as follows, in order of frequency: heart disease (2.7 per 1000); cancer (1.4 per 1000); cerebral hemorrhage; accidents; nephritis; pneumonia; tuberculosis; infant deaths (premature); diabetes; and arteriosclerosis.

CHANGING POPULATIONS

Data on longevity have already indicated a shift in population make-up, as far as age categories and terminal age are concerned. Here we shall consider what has been aptly termed "the numbers racket"—the current increase in total populations.

Although prehistoric *Homo* was irregularly spread over Eurasia, it was not until the end of the Ice Age that Man (now *Homo sapiens*) really began his deployment. Since that time he must be considered a single interbreeding unit, with organic unity—and biologic equality—as a common human endowment. Prior to about 1650 A.D., the time of the "Scientific Revolution" (or "Industrial Revolution") we have no good data. The first great impetus to human numbers came with the "Agricultural Revolution" of about 10,000 years ago. Between those 2 phases we have only guesses or estimates. Bates (1955) gives the world of the Old Stone Age a population of 10 million. Huxley (1956) gives 20 million in 6000 B.C., and 100 million in 1200 B.C. Darwin (1956) gives 350 million at the beginning of the Christian era.

The estimates for 1650 A.D. vary from 470 million (Darwin, 1956) to 545 million (Bates, 1955), to 1 billion (Huxley, 1956). For the 1650–1950 estimates the fullest data are from Bates (1955). The figures are in millions (Table 7).

For a single national group, Cook (1951) gives the following, starting ca. 1600 A.D. with 6 million in the British Isles. In 1950, numbers and dispersal were as follows:

United Kingdom	50,300,000
Ireland	2,900,000
United States	84,000,000
Canada	7,425,000
Australia	8,000,000
New Zealand	1,000,000
Asia, Africa, Pacific Isles	5,000,000
	158,625,000

The population of Europe, he says, has risen from 100 million to 900 million in the interval 1650–1950 A.D.

In terms of world population, whither away? For the future, Brown (1954) suggests 3.4 billion by 1975, 4.8 billion by 2000, 6.0 billion by 2025, and 6.7 billion by 2050. Darwin (1956) sees 4 billion by 2000, 6 billion by 2050. Davis (1957), making estimates from data in the files of the United Nations Population Commission, pessimistically predicts 6 billion by 2000, and 13 billion by 2050. Harrison (1956) graphically concludes that 1 of 20 men who have ever lived is alive today, and goes on to say, "The time may well arrive when a tenth of all of the souls of men, in the strictly Biblical sense, will be inhabiting mortal bodies at one time"!

The rate of increase in world population must command our attention. Numbers, per se, are not enough to highlight the problem. The whole process is self-accelerating, as it were. In the hunting phase of early man the rate of population increase was about 0.1 per cent; now it is closer to 1.0 per cent (Huxley, 1953). In 1956 Huxley said the rate was nearer 1.33 per cent—34 million people are added each year (this is 4000 per hour, 90,000 per day).

Data on the decennial rate of increase are given by Bates (1955) as follows: 2.7 per cent in the 17th century; 3.2 per cent in the first half, and 4.5 per cent in the second half of the 18th century; 5.3 per cent in the first half, and 6.5 per cent in the second half of the 19th century; and 8.3 per cent in the 20th century. Davis (1957) gives higher figures: 6 per cent per decade, 1850–1900; 7 per cent per decade, 1900–1930; 10 per cent per decade, 1930–1950; and 17 per cent per decade, 1950–1957.

There can be no doubt but that we are in a run-away phase of population increase, and that it constitutes a major problem. "Greater threat than the atom!" "Man's biggest headache!" "The human dilemma." "A menace to social progress and to world security." These are banner-lines one reads in the literature.

From total numbers, to rate of increase, to cultural import, is the logical

sequence. The whole business is differentially related to the peoples (nations and social classes) of the world. Gains are not even along all population fronts. First of all (Davis, 1957), peasant-agrarian countries show the fastest increase: Ceylon, Taiwan, Malaya, Paraguay, Costa Rica, Columbia, Mexico, Syria and Turkey. At present rates they will double their populations in twenty-three years; *e.g.*, Mexico with 31½ million now, may achieve 63 million in 1980. This sort of thing may be laid at the door of lowered death rates (due to control of infectious diseases, use of antibiotics and insecticides, and public health education). Here are some examples: in Ceylon the death rate fell 34 per cent in one year, and 70 per cent over a ten-year period; between 1940–1950 the rate in Puerto Rico dropped 82 per cent, in Cyprus 64 per cent, Trinidad 45 per cent, Mexico 43 per cent, and Jamaica 30 per cent.

Longevity and population gains thus are seen to be man-made. It is Man, himself, who has opened the Pandora's box of social change, complexity, and downright chaos. It is up to him to slam the lid! But how? Let's look at numbers first. Long-life we shall consider after we have discussed Man's social structure—his "culture."

The problem of numbers has two major aspects: *reduce 'em!* or *feed 'em!* The first is the more practical but is certainly not the easier, for ethical and moral values are involved. Controlled, *i.e.*, limited, breeding is the only solution. This means world-wide contraception, and involves a re-evaluation of moral precepts—under-privileged conditions for half of a tremendous population, or more evenly distributed cultural and material values for a smaller total group? It poses a real problem: have we the moral right to subordinate *quality* of population to quantity? In simplest terms do we want a lot of "have-nots" or fewer "haves"?

Actually, there is another answer—or another viewpoint. It involves an assumed dichotomy between "haves" and "have-nots." Under present conditions greater numbers can only emphasize this cleavage. But if we relieve the extent and degree of difference between these two groups—if we merge them—then what? This involves 2 processes: 1) increase food supply, and 2) lower, or make more uniform, the standard of living. Maybe we are wrong in trying to Occidentalize the world. It could be that the tide of history is turning toward Orientalization. . . .

Before considering the food problem it may be well to observe what can be accomplished by socially (legally) sanctioned population control. In Japan the 1850 population was 55 million; today it is 91 million. In an area about equal to Montana, 617 persons live in each square mile. In 1948 the birth-rate was 34 per 1000, and the death-rate 12 per 1000; this would have doubled the population in thirty-two years. Population control was established so effectively that the 1955 birth-rate was reduced to 19.4 per 1000, cutting the rate of population growth by half (Davis, 1957).

A biologic solution to a cultural problem is available, and workable. However, biologic fact is one thing, and social acceptance another. Meanwhile the lag between what exists and what is being done is a serious and menacing situation.

THE FOOD SUPPLY OF THE WORLD

During 1947–1953 the world's agricultural productivity showed an 8 per cent gain; in the same period, world population increased 11 per cent (Darwin, 1956). This 3 per cent discrepancy emphasizes the problem of food versus numbers.

The land area of the Earth is about 55 million square miles, or about 36 billion acres. The readily arable land area is only 2 per cent of the total, though Man tills about 10 per cent of the total. If all of the people of the world were evenly distributed, there would be 40 per square mile. Yet 66 per cent of the world population live on about 4¼ million square miles, or about 8 per cent of the land surface (*cf.* Cook, 1951; Brown, 1954; Bates, 1955; Darwin, 1956). The imbalance between land area and population concentration is another aspect of the problem of food versus numbers.

The result? Anywhere from 66 per cent to 75 per cent of the peoples of the world live on a subminimal diet—they go to bed hungry every night! "Within a generation," says Harrison (1956), "the food supply of the world will have to be doubled if all humans are to be fed properly." On the same score Brown (1954) says that in the half of the world which is today poorly fed the increase in food production must be at least 50 per cent. This can be partially achieved by any one, or any combination of the following factors: supplementary irrigation; more extensive use of fertilizer; the breeding of plants for specific environments; improved protection against insects and plant diseases; and the use of special chemical media. If the present world food production be unity, the total result of the foregoing factors would be a 25-fold increase, which could support 50 billion people (Brown, 1954).

More food production is only one possible answer. More efficient use of land or a lowered caloric level (food standard of living) are others. For example, if in North America we secured a yield per acre similar to that in Eastern Asia, we might support 350 million people; if the yield were as in Western Europe, the figure might be 670 million. If yield were maximal and the caloric standard lowered to that of Asia, we could support 1.3 billion "without increased acreage of our crop lands" (Brown, 1954). Or, again, if we could get a crop yield according to West European standards on the 36 billion acres of land of the Earth, the world population could be 35 billion according to United States levels of food consumption, or 90 billion according to Asiatic levels.

Enough facts, figures, hypotheses and theories have been presented on this point to warrant focus upon the one who is accountable for it all: Man, himself! Can he undo what he has done? Can he, in lesser extent, adapt his ways of thinking and doing?

MAN: THE CULTURAL ANIMAL

One hears a lot about psychosomatics, literally mind-body. In a sense the "soma" or organic part is the product of evolution plus modern medical care; the "psyche" or spiritual part is cultural. Thus, we are the products of past and

present, and both predicate the future. We are, today, bio-social, and quite a bit more the latter than the former. Because of this, our immediate future is not so much one of evolutionary progress as of cultural change.

All the available evidence seems to point to the fact that Man's cultural evolution—the sum of his ways of meeting the environmental demands of living—has been divorced from his biologic evolution. Brain and mind, or at least the potentials of working with symbols, concepts and abstractions, came first. The cultural explosion occurred only when Man was organically ready: the forelimbs were freed from locomotion; the hands were adapted to precise movements; the brain was there to dictate eye-hand coordination and neuromuscular skills. Man was organically Man, structurally and functionally, before he became Man the possessor of an advanced culture or "civilization." Call him *Homo sapiens*, *Homo cogitans* or *Homo faber*, he is wise, he is a thinker, he is a tool-maker and a tool-user. He is set apart from all evolutionary predecessors, all living relatives, although Hallowell (1956) postulates a "protocultural level" which preceded a true "cultural level of adaptation," thus linking Man with the infra-human Primates.

Bates (1955) dichotomizes somatic (or biologic) and extrasomatic (or cultural) inheritance, essentially on a time basis: "it seems to take, on the average, about a million years for a species, for a distinct kind of animal, to evolve," but cultures may vary or change every thousand years or so.

Changing Man? Not nearly so much as changing Culture!

There is one change in Man that should be mentioned, for it is in a sense a prerequisite to the cultural attribute of learning. Man is the only animal with a protracted period of infancy and childhood; he is, as it were,vouchsafed a growth-period long enough to provide ample opportunity for the acquisition—by learning rather than instinct—of the common species pool of experience. If ratio of growth-period to life-period be calculated, it is 1:3.5 in Man; in some other Primates it is nearer 1:10; in domesticated mammals it ranges from 1:20 to 1:30. Along with the protraction of learning dependency may have come some increase in body size. Rensch (quoted by Huxley, 1953) feels that a larger body is correlated with increased learning capacity. He found that the larger of 2 closely related species will learn better, but will take a longer time to do so.

MAN: TODAY

The mind of Man, the learning potential of an evolved cerebral cortex, enabled him to focus upon the quality of things, rather than mere quantity. Learning was not merely a pattern, a rote, a sequence, of experiences. There were shades or nuances of experiences, there were new experiences, there were forays into previously unexplored paths. Thus, behavioral complexes arose which, in different combinations, gave rise to group differences as far as cultural organization was concerned. The emergence and efflorescence of human mental activity, as manifest in cultural progress, means a re-orientation of life processes itself. As far as Man is concerned the rather random force of natural selection has given way, in large part, to mental and spiritual drive. "Man can now see himself as the sole

agent of further evolutionary advance on this planet, and one of the few possible instruments of progress in the universe at large. . . . Human society . . . controls matter by means of mind" (Huxley, 1953). Cultural evolution occurs by what the social scientists call "cross-cultural fertilization" (which may be termed "inter-thinking"), just as evolution does by inter-breeding.

Arising from this emphasis upon qualities in life, from the processes of cultural complexities, is a re-focusing of *needs*—no longer the mere organic needs or drives of reproduction and survival, but a sense of values which takes on qualities of spirit and of the very soul. It is difficult to compress into a few words the variable quality of human aspirations. It has been said Man must have a "feeling of certitude" which is inherent in knowledge and in faith. Opler (1956) expresses it: "Human organization and functioning, in social and cultural contexts, is more than bodily needs and physical impulse." Perhaps the closest we can come to summing-up human goals, ideals and visions, is to say that the struggle for existence has in part given way to what Huxley (1953) calls "the struggle for fulfillment." Here is implied the essential value of the human individual. To him fulfillment means the facilitation of his own personality, the realization of his own innate and learned capacities, of satisfaction of material and spiritual needs and drives, and the development throughout life of new qualities of experience. These are enriched by cultural sharing, not only in the formative and productive years but, most of all, in the rich fullness of later, contemplative years. Fulfillment has no "retirement age."

This struggle for fulfillment—and it *is* a struggle—carries with it certain rewards and certain punishments. Man's mind may, and does rise to heights of creative imagination and inspiration; the "minds-eye" is possessed of a vision that transcends the mundane to the levels of human genius, so that cultural progress and complexity may at a bound be impelled forward by the almost cosmic greatness of a mind that may have touched the fringe of the infinite. Here is a reward that can be measured only in terms of the greatness of the human species: Man makes conscious choices, mediated by a conscience; Man may work with abstractions and conceptual frameworks, so that right and wrong in the abstract may be sensed; Man formulates ultimate goals and sets the values to be achieved; Man has defined for himself, has created beauty, and set in motion the mechanisms for its achievement; and Man has formulated the moral and ethical qualities of evil versus good, with guilt the arbiter or penalty of choice or evaluation—his the freedom to choose and to pursue.

This, then, is what Man has wrought by devoting and formulating his mental activity by way of channels of cultural complexity. His rewards are many. His punishment is exacting, for Man has madness—the "nervous breakdowns" which are the toll of a Society that is increasingly intolerant of non-adaptive cultural behavior. Mettler (1955) gives some measure of the price paid (Table 8).

Bortz (1953a) places nervous and mental disturbances as fourth of the 4 most common disorders of later life—vascular deterioration, neoplasia, and collagen disorders being the first three.

TABLE 8

Prevalence of Ongoing Serious Neuropsychiatric Disorders in the United States

Demyelinizing diseases		
Total	8,000	5/100,000
In northern latitudes	6,000	10/100,000
Cerebral palsy (major congenital defects)	500,000	300/100,000
Born annually	11,000	
Expected mortality in infancy	1,500	
Expected life institutionalization	3,000	
Remaining in society	6,500	
Convulsive disorders (epilepsy)	750,000+	500/100,000
Serious psychiatric disorders	2,800,000	1,750/100,000

Quite apart from the problem of the mental dangers of cultural conflict is the problem of the variables of normal age-changes in mental ability and its formalization in cultural pursuits. Lawton (1943) states that mental ability (measured by "intelligence tests") develops early, levelling off at 20–25 years; after that there is decline, accelerating after 40 years, so that by 55 years mental ability has receded to a 14-year-old level. Reaction-time is at its peak between 18–22 years, as are also immediate memory, and the ability to learn new things (the decline in learning-rate is said to be 1 per cent per year after age 25). By the age of 70, strength, skill and sensory acuity have declined to one-fourth to one-third of their 25-year-old level. On the credit side of the ledger, it may be said that creative imagination is ageless; further, the gifted individual is favored, for the greater the innate intellectual endowment the less the decline, both relatively and absolutely. Over and beyond the age factor, per se, there are important emotional complexes in older individuals: family adjustments; feelings of adequacy or inadequacy; financial security; attitude toward ageing; and physical well-being (*cf.* Cavan, 1952, and Havighurst, 1952).

By 1975 or thereabouts we shall have 17–20 million people over 65 years of age. The basic problems are in the socio-economic realm, of course, but the economy side of the picture must flow from the social aspect, *i.e.*, if Society says so, then older people will fit into the cultural pattern without serious dislocation. Does Society say so? With Simmons (1945) we may observe the role of the aged in primitive society, assuming (or hoping) that favorable reactions and values may be translatable in our own civilization. In primitive society the aged have *prestige*, "but only under culturally determined circumstances, and for a limited age period which rarely extends into decrepitude." *Longevity* is "very widely regarded as a just reward to those who led good moral lives and obeyed all the rules" (for example, the Hopi say, "Whoever is not mean will live long"; the Labrador Eskimos say, "He who encounters head winds will live a long life," *i.e.*, he who is courageous). *Security* in old age has been achieved by "active association and assistance in the interests and enterprises of others" via a counselling or consultative role that we may term "the voice of experience" or "an elder statesman."

Certain it is that our presumably enlightened culture has accepted in principle the moral values inherent in responsibility for those of later years. But a sense of responsibility is one thing; doing something about it is another! How is our economy absorbing our senior citizens? The most serious attempt to answer this question is by Le Gros Clark and Dunne (1956). They concluded that "the capacity of men to continue beyond their mid-sixties depends mainly (and for the general run of men) upon the actual jobs they have to do." Welford (1957) suggests caution in interpretation:

> It seems clear that many of the methodological problems commonly supposed to attach to the study of human performance in relation to age are less serious than they are usually believed to be. Difficulties arising from the brevity of laboratory experiments can be met by studies of work in industry. Motivation among older subjects does not seem to be a serious problem. The bewildering complexity of human capacity can, at least to a considerable extent, be sorted out. Various background factors affecting the comparability of subjects of different ages can be controlled.
>
> On the other hand, it seems equally clear that no one way of studying ageing is wholly free from methodological[1] objections and that we can thus seldom, if ever, draw certain conclusions from a single experiment or industrial study. In view of this it appears wiser to carry out several small-scale studies using different methods rather than concentrate the whole research effort on a few large-scale investigations. Even a study using thousands of subjects recruited haphazardly would be at the mercy of possible sampling errors. The use of a number of small-scale studies each controlling different variables enables us to gather on our way a great deal of valuable information upon the effects of various background factors influencing age trends, and although giving a mass of data which it may often be difficult to integrate, holds the promise of the attainment of results having a greater degree of generality.

The foregoing statement acknowledges the potency of motivation among older people. Beyond doubt there is the wish, the need, to succeed or, rather, to continue to be successful in one's prime-of-age role. Add to motivation the inestimable values of experience, of know-how, and qualifications remain at an acceptably high level. An older employee may be likened to an older baseball pitcher who, when his "fire-ball" left him, "threw with his head instead of his arm." There may be, in many occupations, some lessening in dexterity and quickness, true; but employment may still continue, for example, at a teaching or supervisory level. A terminal age, say 65 years, is a waste of human material, an emptying of a reservoir of knowledge, experience and wisdom. Most mandatory retirements are uneconomical.

MAN: TOMORROW

There is a repetitive sequence in thinking about Man's future that runs something like this: Man has made Culture; cultural advances have been achieved by way of great ideas inspired by great minds; Man's future development is cultural rather than biologic; hence, the rate of cultural evolution may be accelerated if the general level of human intelligence is raised, in part by a greater frequency of very exceptional minds, *i.e.*, geniuses. Indeed, along these very lines, Rostand (1952) states that one of the major problems of "compulsory eugenics" is to produce more geniuses (another, which is complementary, is to eliminate defectives).

Can intelligence be increased by selection? The answer will be in the affirmative, if intelligence—however measured—has a biogenetic basis, *i.e.*, is heritable. Dobzhansky and Montagu (1947) take the position that such selection is already operative. They maintain that the most important trend in the human species is toward "genetically determined educability." Simpson (1949) states that "there is ample evidence that intelligence is if not strictly determined at least strictly limited as to potentialities by inheritance." In the same year the English Royal Commission on Population ventured that a considerable element in intelligence is inherited.

There is no reason, therefore, to do other than accept the very real possibility that the sum of human intelligence will be increased—with all persons at a higher level, and many at the highest level of potential. It is *mind* that will improve, not necessarily brain. Certainly there is no need to postulate a bigger brain—merely a more efficient one (mayhap the associative "hook-ups" will improve, as a phase of better internal neurophysiologic organization and function).

The future of Man is in his own hands. Bates (1955) aptly observes that the problem is "not so much in terms of the perfectability of Man, as in terms of the improvability of culture." It is culture which is the more malleable, the more plastic. It is by way of cultural progress, therefore, that we shall enhance desirable psycho-cultural and physical traits in Man: heightened general intelligence; the possession of diversified and special aptitudes; increased physical vigor; greater immunity to specific defects and/or diseases; and greater security, richer fulfillment, leading to reduction of personal-cultural tensions and stresses. These, in a total advance, cannot but enhance Man's spiritual nature as well: his appreciation of his own human kind, his recognition of the dignity of the human individual, and his understanding of human values in universal terms which lead him inevitably to the Creator of all Life.

The achievement of these goals is dependent upon many cultural factors: rate of population growth; rate of consumption of basic raw resources, and development of new resources; rate and amount of agricultural improvement; extent of industrialization in present urban-agrarian areas; and the avoidance of disastrous wars. Given all of these in favorable and successful context and degree, there is no real bar to Man's cultural evolution to an almost Utopian plane!

Not all are as optimistic as this. Brown (1954) observes:

> With increasing necessity and demand for efficiency, integration and minimizing of waste in the economic world, there will be increasing demand for efficiency, integration, and minimizing waste in the social world. These changes will have marked effects upon the ways in which men live. It seems clear that the first major penalty man will have to pay for his rapid consumption of the earth's non-renewable resources will be that of having to live in a world where his thoughts and actions are ever more strongly limited, where social organization has become all-pervasive, complex, and inflexible, and where the state completely dominates the actions of the individual.

Mettler (1955) sees only a continuation of present trends: technological advances, toxic hazards, high velocities, radiation dangers, and synthetic foods with greater percentage of insecticides and fungicides, dye products and hy-

groscopic agents. Harrison (1956) makes a statement that is rather disconcerting, if not alarming: "If life on earth today is a trillion times as complex as it was a billion years ago, it can well become a trillion times more complex, ordered, and meaningful at an equal time in the future." This is "more of the same" with a vengeance!

MAN: APPRAISAL

There can be no doubt that Man has changed, is changing, and will change. He has traversed a road laid down by natural laws; the road ahead will be fashioned and directed by him. Man has partaken of all advances, all progress, all specializations, in organic evolution and has profited by all adaptations. Especially has he profited by an evolving nervous system that has proceeded from nerve-net, to ganglion, to cerebral cortex, to mind. It is this progression, and its final culmination, that makes Man one with Destiny—his own destiny, for his will be the guiding spirit.

Man is relatively recent in the life-succession. Hominid traits are no more than 10 million years old, the genus *Homo* perhaps a million or a bit more, and the *species* only about 100 thousand years old (or perhaps only half of this amount). During this time he has not changed very much—at least his brain hasn't. It is his *use* of the brain which has changed, involving the emergence of verbal communication, and a distinctly human heritage of a common pool of experience. As a result a broader neural function has appeared—a brain that may govern a body, and a mind that may sway a life. The answer to this duality? A functioning human organism in a functioning social organization. This is why Man now transcends the rigors of natural selection. He has set up a cultural framework which is selective because it is adaptive; and it is Nature that is being bent to the will of Man, rather than vice versa.

Following from this newer order of things are 2 major consequences, 2 incredibly complex problems: first, Man is living longer, so that an old-age group (65 years, plus) is progressively dominant; secondly, Man's numbers are increasing at an alarming rate. We are told that by 2050 A.D. we may have a world population of anywhere from 6 to 13 billion, of whom (as now) 66–75 per cent will have to live on a subminimal daily caloric intake. More people; more older people; not enough food. This is the trilogy which "changing Man" has wrought. Concomitant or associative changes are to be found in poorly adjusted personal-social relationships; but these, in every real sense, flow from the basic three. It is these with which Man must cope. And the answer?

Man's own spirit, Man's resilient nature, holds the answer. This evolved Mind, rooted in the organic raw-stuff of the cortex, holds by its very nature the faith, the belief, the power, to achieve oneness with the Infinite. Man, made but a "little lower than the angels," is on the way to realizing the divinity latent within him.

Through his culture, changing Man has freedom of choice. The highest potentials of mental and spiritual advance are his, does he but grasp the vision of his mind's-eye, inspired faith in God.

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CONFERENCE ON OLDER FOLKS—A RISING NATIONAL PROBLEM

REMARKS

ALFRED PUTNAM*

Lankenau Hospital, Philadelphia, Pennsylvania

It is a pleasure and an honor to welcome such a distinguished group of physicians and scientists to the hospital. I bring you the good wishes and admiration of the entire Board of Trustees and I know that your discussions during the meetings just held and the one which will be held this evening, will be fruitful. I welcome also the men and women of our community who are with us this evening and to them I wish particularly to emphasize that the Lankenau Hospital has always been, and always will be, hospitable, proud of old friendships and rejoicing in new ones. Our doors are always open to people of good will. Only four or our ninety-seven years have been spent in our present location. We are anxious to serve the people who live here and hope that by conscientious service we may merit their confidence.

Because I lack scientific knowledge of geriatrics I have sought help from what other people have had to say about old age. Most of the quotations are cynical, some are amusing and, thank God, some are optimistic and vigorous. Oliver Wendell Holmes the elder said "A man over 90 is a great comfort to all his elderly neighbors: he is a picket guard at the extreme outpost; and the young folk of 60 and 70 feel that the enemy must get by him before he can come near their camp." Joel Chandler Harris is supposed to have once observed, with rather acetic humor, "I am in the prime of senility." But Walt Whitman speaks of the "grandeur and exquisitness of old age," and we have all known people who have been able to live thus triumphantly. We all know these lines from the poetry of Robert Browning, whose name is almost synonymous with courage:

> "Grow old along with me!
> The best is yet to be,
> The last of life, for which the first was made."

Thomas Jefferson said "Tranquillity is the summum bonum of old age;" and Plato, "It gives me great pleasure to converse with the aged. They have been over the road that all of us must travel and know where it is rough and difficult and where it is level and easy."

Old age, it seems to me (a happy young man of 62), can be grim and sad or it can be magnificent, depending upon character, spirit and physical condition. So it is wise and proper for learned men and women to gather at this hospital we all love so much, and may God bless their research and reward their efforts. I hope that in twenty or thirty years I shall feel as all of us do now—hopeful of the future and sure of the goodness of life.

* President, Board of Trustees, Lankenau Hospital.

The reason for making these short and inadequate remarks is because I should like to convey to all the readers of this Journal the enthusiasm of everyone connected with The Lankenau Hospital for the work that is being done by the members of the American Geriatrics Society. Always, and at any time, you will be gladly received at Lankenau. We shall make available to you the things that we have learned and we shall hold ourselves in readiness conscientiously to study with, and learn from you.

REMARKS

RAYMOND F. HOSFORD, F.A.C.H.A.*

Lankenau Hospital, Philadelphia, Pennsylvania

The concept of a general hospital in our modern society is changing. It might be likened to a concept of religion as expressed by President Ezra Stiles of Yale toward the close of the eighteenth century, and more recently by Harry Emerson Fosdick. They compared the changing concepts of religion with the changing astronomies resulting from continuing scientific discoveries. The stars still remain constant just as God remains constant. It is our concept of them that changes. Philosophical, psychological and sociological changes are making a continuing impact on medicine and health. Therefore we must be sensitive to these changes and evaluate them with a curious and unbiased mind.

Our concept of the general hospital is a health center dedicated to a program of positive health. In addition to conventional care of the sick and injured, we endeavor to prevent disease through knowledge gained by research and education and to detect disease in its early stages through periodic health examinations. We hope to enable people not only to live longer but to maintain their physical energy and mental alertness through the entire life span.

For the lay public we have developed a Health Education Program centered around our Health Museum with its widely varied types of exhibits, including Guide-a-Phones that make possible a walkie-talkie type of lecture as the visitor views the exhibits. Visitors are also taken to our auditorium where they are shown "Pandora" (the transparent talking woman), colored slides of the hospital, and health films on selected subjects. Special health programs open to the general public are held at frequent intervals and members of our Medical Staff may be secured through our Speakers' Bureau for health programs held elsewhere in the community.

Our education program at the professional level includes, in addition to training of residents, interns, fellows, technicians and nurses, a series of special scientific lectures and seminars for the medical profession similar to the research seminar on "Maturing Man" which was held here today.

New facilities are presently being constructed to house our expanding research program. We shall be primarily interested in studies of cardiovascular diseases, cancer, arthritis and rheumatism, neuropsychiatry, alcoholism, and energy maintenance in our senior citizens. In order to prepare ourselves better for this great undertaking Dr. Kaare Rodahl, our Director of Clinical Research, and I visited research centers in six European countries this summer, where we gained a wealth of valuable information.

We recognize that we are not necessarily the only group engaged in these various activities but we know of no other general hospital anywhere in the

* Director, Lankenau Hospital.

world that is endeavoring to incorporate and develop a total health program at a single location under the direction of a single medical staff and under the control of a single board of trustees.

We should like to extend a cordial invitation to professional people who share our interest in the problems of aging, to visit our hospital and exchange information on this vital subject.

OLDER FOLKS—A RISING NATIONAL PROBLEM

BERWYN F. MATTISON, M.D.*

State Department of Health, Commonwealth of Pennsylvania, Harrisburg, Pennsylvania

Perhaps it is not proper for me to open my remarks by quarrelling with the title given to our evening session. You have had a very well planned program today, one which illustrates the tremendous complexity of the problems you have been considering. It has represented the diversity of skills which must be brought to bear to achieve a solution of the many problems facing us in relation to our maturing population. But I simply cannot allow tonight's theme, "Older Folks—A Rising National Problem," to go unchallenged.

Won't you agree with me that what we are really discussing is, "Older Folks—Our Richest Untapped Resource?" We have talked for a number of years now about the conservation of human resources. However, we seemed always to end up talking about the protection of our youth or improving the health of our labor force, which usually means our middle-adult age groups.

Too often we have fallen into the traditional pattern of assuming that chronologic age is paralleled by an increasing extent and variety of chronic ills; and that the extent and variety of these ills must in turn be paralleled by declining physical, mental and emotional productivity.

It is high time that we questioned the validity of these assumptions and set ourselves new goals for the prevention of the unnecessary and unconscionable waste of those fruits of the minds, the imaginations and the learned skills of these most experienced of our citizens. In a century and in a nation in which disease after disease has been conquered during recent decades, this should not seem impossible to the most skeptical. Let us examine some of the progress that has been made and some of the potential for the immediate future.

Much has already been done. Most of us can remember during just the past twenty years the substantial eradication of certain types of disabling illness in the latter years of life. No longer do we frequently see cases of what used to be called locomotor ataxia, signaling the final nervous stages of syphilitic infection; nor do we see the aneurysms and aortic disease caused so often in years past by that same spirochete. There are now relatively few elderly people suffering the crippling results of amputations; they are no longer necessary because of better medical treatment of circulatory disorders as well as improved surgery. In the rare cases in which amputation of a lower extremity is necessary, prosthetic devices have been improved so much that their use is no longer the disfiguring and disabling problem which formerly forced elderly amputees to a life in the chair or the bed. The active and early rehabilitation of victims of cerebral accidents has revolutionized the prognosis regarding self-sufficiency in all but the most severe cases

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Since Nov. 18, 1957, Executive Secretary, American Public Health Association, New York, N. Y.

of this scourge of our later years. Fractures are still distressingly frequent as a result of home and vehicular accidents, particularly amongst the elderly, but their management has improved so greatly that early ambulation and later complete recovery is the rule rather than the exception. These are but a few of the developments of medical science during the recent past, which are changing the outlook of our mature citizens. When made more completely available to everyone, they can help to convert the "problem group" to a continuing rich resource of human endeavor and productivity.

Basic research

However, you have heard today and will hear in the featured papers tonight, more about the many things which remain to be done and which so far have been promises rather than achievements. Probably foremost amongst these incompletely exploited fields is basic research. Many of the secrets (physical, chemical and emotional) of the aging process remain to be unlocked. After what our previous speakers have said I doubt if any of us would question the probability that in the years just ahead many of the so-called "aging processes" will be found to be just as preventable as many of the "disease processes" have been in the past.

Physical rehabilitation

Physical rehabilitation is the youngest branch of medicine and has proved its truly miraculous potential when applied early and with the necessary interdisciplinary facilities to perform a complete job. Much more can be accomplished in this field—not just in relation to vocational rehabilitation, but in the field of making individuals self-sufficient (if not economically independent), thus converting a difficult personal problem into a simple maintenance one.

Nutrition

Probably nearly as important will be the application of the newer knowledge and the development of more knowledge in the field of nutrition. The relationship between continued proper diets and the prevention of some of our chronic, low-grade anatomic changes which inhibit physiologic effectiveness, must be studied much further, as the data at the present time are equivocal. However, the available information indicates that this may well be one of the major avenues for preventing or delaying certain changes which have seemed inevitable in the past. Let me point out that this is not just a matter of effect on cardiovascular physiology; it also has its role to play in the maintenance of energy levels, the preservation of dental health, and even the maintenance of emotional and mental health. The broader application of already known nutritional principles in nursing homes caring for elderly patients could be of inestimable value.

General care; nursing homes

Surgeon General Burney recently pointed out in an article in the *Journal of the American Medical Association* that simple things like the maintenance of

dental health, the provision of proper visual and auditory aids, and the competent care of the feet, can wipe out much of the misery which has plagued elderly patients. He also stressed the need for improved operation of our nursing homes.

Yet, I must say, parenthetically, that good nursing homes for the care of the chronically ill and aging can scarcely be accepted as a complete solution for that part of the problem. Many persons formerly hospitalized indefinitely in some such facility can now be rehabilitated and, with proper home arrangements, return to their families and their communities as productive and useful citizens. Particularly important would be abolition of the financial premiums for keeping a patient bedridden in the nursing home—which is the current situation in some areas. The provision of adequate supplementation of home care in terms of nursing, physical therapy and social and nutrition services, is every bit as important as simply increasing or improving nursing home facilities.

Chronic disease control programs

How does Pennsylvania stand in relation to other states, so far as our toll from chronic disease is concerned? Perhaps a few facts on this point may illustrate the need for strengthened support for chronic disease control programs in the years just ahead:

Tuberculosis is still one of our most serious chronic diseases of later life. We have a vigorous control program, developed over the years, that has produced gratifying results in lowered mortality. Our most recent comparative figures, those for 1955, show that in Pennsylvania the mortality rate (11.2 deaths per 100,000 population) is slightly higher than that for the United States as a whole, but not significantly different from the average for our neighboring Middle Atlantic States (11.1 per 100,000).

In the field of malignant neoplasms we have had an aggressive control program, and the results have been similar. Pennsylvania has a somewhat lower mortality (167.6 per 100,000) than that of our nearby states (180.1 per 100,000).

However, in those fields of illness so far neglected by major program emphasis, we do not fare so well. Our death rates from diabetes, from cardiovascular disease, and from vehicular and non-vehicular accidents are well above both the national average and the average for our neighboring states. Thus the diabetes mortality rate in Pennsylvania is 22.5 per 100,000 against 15.5 for the nation and 21.1 for the Middle Atlantic States; the mortality rate for heart disease is 597 in Pennsylvania against 506 for the nation and 590 for our neighbors; the rate for motor vehicle accidents is 17.9 in this state against 15.6 for this region; and the rate for non-vehicular accidents is 34.1 in this state against 33.5 for the nation and 31.1 for this region.

These differences are not due to differences in the age pattern of the State. As a matter of fact, age-specific mortality rates from these causes show even greater proportionate differences in the age groups over 65.

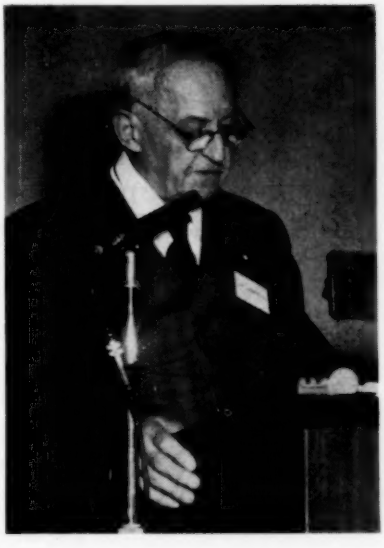
It is noteworthy that whenever active and informed programs of home-accident prevention have been forcefully executed, this particular health hazard that so frequently involves our older citizens has been lowered significantly.

You have heard today some extremely interesting examples of the variety and ingenuity of our attack on the problems of aging. I have attempted to sketch some of the additional approaches for the future. I am sure that the speakers whom we are to hear tonight will extend that vista and help us to see more clearly how we can transform a problem into a continuing utilization of that rich human resource—our senior citizens.

THE CHALLENGE OF AGING

THE HONORABLE LEROY E. CHAPMAN, M.D.*

Harrisburg, Pennsylvania



DOCTOR CHAPMAN

In the year 1900, American life expectancy at birth was 47 years. By 1950, life expectancy at birth was 67 years for men and 71 for women.

In 1900, persons over 65 represented 4.1 per cent of the total population; by 1950, this figure was precisely doubled.

In 1950, of Pennsylvania's population over 65 years of age, 21 per cent of the men and 57 per cent of the women had no money income whatever, and of those over 65 who had some income, the men averaged $1,400 a year, whereas the women averaged but $560.

In 1900, about two-thirds (66 per cent) of the population over 65 was actively in the labor force; by 1950 this figure had declined to about one-fifth (21 per cent).

In 1950, 24 per cent of people over 60 admitted to mental hospitals were admitted for mental conditions directly associated with old age.

These may sound like dry statistics, but the observant student of sociology would be quick to realize that they are statistics of dramatic significance to the pattern of our culture.

The tremendous increase in life expectancy since 1900 points up the fact that people are living longer, so that our population today is composed of a greater percentage of older persons.

Statistics of income and of the number of older citizens active in the labor force are indications of the economic and social problems which increasing numbers of elder persons in the population are experiencing. The number of elder citizens admitted to mental hospitals for illness directly associated with their age, accents these problems, and emphasizes the extreme toll taken by the psychologic, physiologic and social stresses faced by older persons. In view of the fact that more and more people are reaching the upper age levels, it is of supreme importance to be aware of the problems involved in these statistics.

ATTITUDES TOWARD AGING

Perhaps the greatest and most all-inclusive problem which affects the older person is the lack of a constructive attitude toward the aging process. There are as many attitudes towards aging as there are cultures. Even the time of onset

* Senate of Pennsylvania.

varies with the society; old age is attributed to people of primitive groups at a much earlier period chronologically than in advanced societies such as our own. For example, among one native group in the Pacific (Bontok Igorot in the Philippine Islands), a person is considered "in the prime" at 23, "getting old" at 30, "old" at 40, and "a mass of wrinkles from head to foot" by 50.

Attitudes toward aging vary as much as the definition of the period of aging. It is interesting that most primitive societies tended to conceive of the later years as the best and most satisfying period before any substantial number of their population reached these years.

We have tended to reverse the concept. We have progressed greatly in guaranteeing longer life for more people, but at the same time have disrupted many of the time-tested patterns of older people and perhaps have even regressed in handling the problem of successful aging. Within the past fifty years, the proportion of older people in the population has doubled. But, even within this short period, the older person's satisfactions from life, however limited, have changed.

In the past, in our culture, a man who attained 65 "retired" to his family group when he could no longer engage in active tasks. As part of a large, self-sufficient consanguineous family, he still played an important role as the nominal —if not actual—head of the family. However, with the rapid shift from an agricultural to an industrial economy during the past half century, the older person can no longer find even the limited satisfaction once available of being part of a large family group; urbanization has tended to promote the smaller, two-generation family unit, in which older people have no satisfactory role. Fewer children and longer-lived parents in the new type of economy have made it more difficult for the middle generation to care for both their children and their aging parents. Faced with the necessity of choosing, people have favored the children and have left the older generation to be cared for by the community. Thus, older people have been considered of limited use to the community and consigned to rocking chairs, to dreary rooming houses, to nursing homes and even to mental hospitals.

Although many older people have accepted this concept of their limited usefulness, they have been dissatisfied and frequently bored and discontented. They have been denied the opportunity to participate effectively in their groups, to win respect from the community, and to respect themselves.

These attitudes and social practices which have tended to deny the needs of older individuals and their potentialities for social contribution have superimposed unnecessary social problems on the biologic forces in aging. We need a new concept of aging which recognizes the potentials for both enjoyment and contribution by older individuals.

We are beginning to move toward a new concept of maturation, questioning the validity of earlier social judgments about older people and exploring the nature of both individual and population aging.

Our growing awareness of the problems of the older members of our population has given birth to a whole new branch of science, which we refer to in the broadest sense as gerontology. I think "new" is an apt designation for a science which has

actually grown up only since 1940. Prior to that time, our sciences—particularly the art and science of medicine—were concerned primarily with the young and vigorous and the maintenance of youth and vigor. The numbers of old people in our population were not significant, and in any event were considered, in family and community alike, a sort of unavoidable economic burden. It is something of a paradox that the very concern with youth and the prolonging of life—and some amazing developments have taken place in the last quarter century—should result in the creation of a situation wherein science must now concern itself with the problems of life thus prolonged. For many years, our whole attention was directed to fighting the diseases of childhood and to the control of infection, which once limited severely the numbers of people living to a "ripe old age." Now we are coming to a realization of the necessity for giving some attention to caring for those whom science has given longer life and whom age has made prey to the degenerative diseases.

MEDICAL PROBLEMS

The attention thus focused on the medical problems of the aging has served to dispel many misconceptions about the aging process, though many others persist. We know now, for example, that the aging process actually begins at birth and that it is a natural part of human growth and development. We know that the latter years of human life are marked by a slowing of responses, a lessening of the body's ability to repair itself, and diminished food requirements (although a lesser tolerance for certain dietary deficiencies). Nevertheless, we are largely heedless, or unaware, that the ability to learn, for example, diminishes much less rapidly than commonly thought. Many of us automatically assume that learning ability reaches its peak in the early twenties, and some of us are inclined to think that it declines rapidly after reaching the peak, whereas in point of fact it diminishes so slowly that our ability to learn is actually the same at age 80 as it is at age 12. We are inclined to emphasize the fact that speed of performance is diminished and responses are slower with advancing age, while overlooking the fact that endurance and competence often actually improve. And judgment increases with age, but this, too, we tend to overlook. Admiring only the physical prowess of youth, many of us discount entirely the mental prowess of the older person.

What about physiologic changes in the older person? Some types of illness, particularly chronic illness, seem to appear with greatest prevalence among older people. Arteriosclerosis, hypertension, diabetes, arthritis, cancer, senile dementia—these are not diseases of youth. To this question, geriatrics is slowly but surely coming up with answers.

You are all aware that geriatrics is not a medical specialty in the strictest sense of the word, inasmuch as it crosses the lines of other specialties. There are problems of a geriatric nature, for example, in ophthalmology, dermatology and surgery. Geriatrics is concerned not only with the sick but with the well; and not only with those already 60 or older, but with those in middle age, when so many of the illnesses which attack during the later years actually have their

beginnings. Nor is it concerned solely with the physical aspects of aging, but with the intellectual and emotional aspects as well.

Geriatricians have demonstrated that the degenerative diseases take the lives of many of our elder citizens 1) because such diseases begin insidiously and progress slowly; 2) because aging bodies react less violently and show milder symptoms, so that the disease is frequently not brought to the attention of a physician until it is far advanced; 3) because such diseases are generally internal in origin and varying in cause, and hence are difficult to treat *or* prevent; and 4) because their occurrence in the aged person is frequently multiple, increasing vulnerability and decreasing resistance.

Older people are prey to such degenerative diseases because their bodies have been abused by the cumulative effects of poor nutrition and inadequate handling of stress. These abuses make the aged person prey to psychosomatic disorders, as well as encouraging the accelerated development of arteriosclerotic diseases. The incidence and severity of degenerative disease can be lessened by careful nutritional balance and proper control of metabolic activity throughout the life span. The primary objective of geriatrics is not merely to prolong life, but also to modify the abnormalities characteristic of senescence and to restrain the progressive disorders of later years, thus adding to the health and usefulness of the elderly. Geriatrics, therefore, is only one aspect of the study essential to meeting the needs of older persons, which must also include biology, sociology and psychology.

NEED FOR A NEW CONCEPT OF AGING

My younger colleague and Chief of Medical Service here at Lankenau Hospital, Dr. Edward L. Bortz, has made this same point in his researches—that the real problem is to maintain the physical and mental capacities of older people so as to preserve their personal dignity and sense of independence by helping them to continue as useful members of society. As he phrased it so aptly, "it is for science not only to add to the years of life, but more important, to add life to the years."

The restoration of the older citizen to a useful place in society will have marked effects upon both the individual and the society at large. I believe that we must revise our thinking in the matter of relating usefulness to society with chronologic age.

When you proceed to consider the situation logically and thoughtfully, you cannot but realize that our relegation of most of our older citizens to a seat on the sidelines is nothing if not inconsistent with observable fact, and even with what you might call national policy in at least one area. There are men and women in all walks of life who have not only continued as useful members of society though well past "retirement age," but who have undertaken and accomplished tasks that younger men would find arduous. I can think of all sorts of examples among famous men and women to illustrate this point. Albert Schweitzer, for instance, has refused to let 82 very full years of living interfere with the continuation of his work as a medical missionary in Africa. Bernard

Shaw was nearing 70 when he was awarded the Nobel Prize for literature, and continued for many years to create the great plays still performed on stages throughout the world. Cecil B. DeMille at 76 looks forward to producing more of the spectacular motion pictures which have been his life's work; and Bernard Baruch did not retire to obscurity when he reached 65, but continues in his role of elder statesman and adviser to presidents.

It is to the presidents I refer when I speak of our attitude toward the aging as inconsistent with what amounts to a national policy. With few exceptions, the men we have elected to fill our highest office have been men past 50. Seven of them (including the distinguished gentleman who now resides in the White House), when elected, were past 65 or of an age which would make them 65 before the end of a four-year term. In this one area at least we almost invariably feel that the experience and judgment which accrue with years of living are vitally important. Why, then, are we so ready to overlook the importance of these factors in many other cases? Henry Ford is reported to have said, and I cannot but agree: "You take all the experience and judgment of men over fifty out of the world and there wouldn't be enough left to run it."

I am happy to say that I am not in the position of having to devote this entire presentation to pointing up the *need* for a new concept of aging which gives full attention to both the medical and social problems faced by older persons in our society. I can also report that these problems are today the subject of study and action, and that progress is being made.

In 1953, the Joint State Government Commission, Pennsylvania's legislative research agency, published a report on its study of the aged and aging which set forth some startling facts, particularly regarding the economic position of our older citizens. Some of the statistics I quoted at the beginning come from this study. Since the time of its publication, several new programs designed to benefit the aged have been put into effect in Pennsylvania, and it is these programs which I should like to describe to you briefly.

It is impossible to think of these programs in terms of order of importance, so I shall simply outline them one by one. In our Department of Labor and Industry we now have an Advisory Council on the Problems of Older Workers, composed of 9 appointees of the Governor and a small administrative staff. This council, in addition to recommending programs for the worker aged 45 to 65 to the Bureau of Employment Security, assists in developing county and community advisory boards to alleviate local problems affecting older workers, coordinates the activities of various groups interested in older people (furnishing specific aid on employment problems and other referral services), and disseminates material concerning older workers which is designed to acquaint them with available services and to make employers aware of their potentialities.

Our Department of Welfare, too, now has a Bureau of Services for the Aging, which includes a Division of Community Consultation and a Division of Community Standards. Through these 2 divisions, the bureau acts as a referral service for other departments concerned with the aged; assists in the development of programs for the aged by social agencies, labor and industrial groups,

mental health organizations, and service groups; assures fulfillment of legal requirements for licensing approval of institutions for the aged, and encourages improvement of sub-standard institutions into ones which will meet the standards; publishes a series of operating manuals for institutional management; and provides institutes and training programs for institutional operators and administrators under the jurisdiction of the Department of Welfare.

In January of this year, Governor George M. Leader appointed 17 Pennsylvania community leaders to this Governor's Committee on the Aging. This committee will attempt to determine the needs and resources of the aging segment of the Commonwealth's population, hold conferences in an effort to make the general public aware of the resources necessary to solve the problems presented by older people, and eventually report its findings to the Governor with recommendations for a program of action by both the executive and legislative branches of the state government. Staff services to the committee will be provided by the Bureau of Services for the Aging in the Department of Welfare, and a monthly bulletin outlining programs available to older people is planned.

In association with the programs of these new agencies and the programs (such as chronic disease control and old-age assistance) of the Departments of Health and Public Assistance which affect or are related to the aging, a new committee—the Inter-Departmental Committee on Problems of the Aging—has been established. The task of this committee will be to coordinate the work of the various boards, bureaus and departments concerned. It is hoped that its operations will serve to eliminate duplication of facilities and services to the aging and permit the development of policies by each agency which will complement the work of the others. This seems to be a considered and judicious course of action, inasmuch as we are, for all practical purposes, new operators in this field. In the present state of knowledge we cannot determine the advisability of establishing a single agency to deal with all phases of the problem.

Thus far, I have discussed some of the problems—both sociologic and biologic which exist for many of our older citizens, and the ways in which attempts have been made to determine the best means of coping with them. It seems to me, however, that we are too much accustomed to hearing a great deal about the problems but very little about the opportunities of older people, as if aging were to be regarded as a curse in spite of all our efforts to attain a long life. We forget that the fact that so many of us reach the later years is a most remarkable achievement, made possible only by recent medical advances. The tendency of most of us is, mistakenly, to regard old age as a discredited extension of middle age. This conception of old age implies a pattern of adjustment characterized by a precarious attempt to hold on to the norms and patterns of the middle years, coupled with a resentful and slow retreat from these norms, rather than a challenge for a different kind of life.

There are many justifiable reasons for assuming that a shift from mid-life to later life can be as significant and challenging as the change from adolescence to adulthood. We may find it very profitable to explore the possibilities that old age in our modern civilization provides for new ways of self-expression, new

modes of living—ways as different from those of middle-age as adolescence is from adulthood.

I need also to stress the fact that people have aged most successfully in every culture when they have found effective roles in the community of which they are a part. Every resource available must be utilized to rediscover and develop the potentialities of older persons everywhere. In doing this, not only will you give new life and hope to more aging persons, but also benefit from the knowledge, wisdom and good judgment in all areas of living contributed by older citizens.

SIGNIFICANT AREAS OF RESEARCH IN AGING

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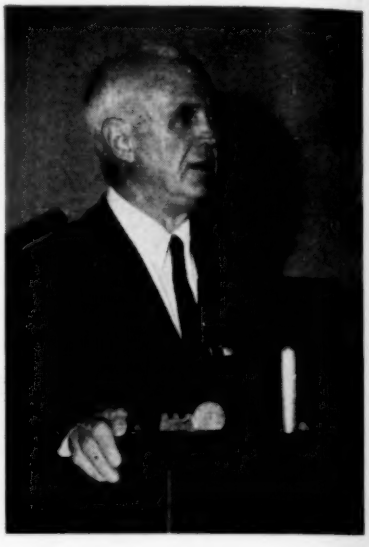

DOCTOR COWDRY

There is nothing new about attempts to discover what are the most important and feasible lines of research dealing with the problems of aging, unless it be their degree of success—which the future alone will show. This task is called, for short, "problem identification."

I venture to consider tonight only medical and biologic aspects, realizing that the economic and social aspects are of no less importance. It does not profit a man much if he has good health in his old age, yet loses his home, his friends, and is alone and starving with nothing to do.

The Josiah Macy, Jr. Foundation, encouraged by the results of a survey of the problem of arteriosclerosis, has become the principal pioneer and has held no less than 15 annual conferences on these problems of aging. The last one was in Princeton in 1953. Its transactions were edited by Dr. Nathan W. Shock and were published by the Foundation in 1954. With minds cross-fertilizing minds at leisure and under the most favorable circumstances, these conferences have helped to shape researches on aging in the United States. But no attempt was made to give priority to particular problems.

Lord Nuffield had a small conference on problem identification in London in July, 1950. This was continued and results were formulated a few days later at the First International Gerontological Congress in Liége. Since the whole science of gerontology was naturally involved, including nonmedical aspects, a fairly wide range of problems was selected. It is significant that cardiovascular disease was given a high rating.

About this time, the Division of Medical Sciences of the National Research Council entered the lists. Its committee, headed by none other than Professor A. J. Carlson, deliberated long and carefully. The result was a strong recommendation that available resources be concentrated on a single objective—a study of alterations in basal metabolism with advancing age. This study was to have been supported by a budget of $50,000 a year for a considerable period; but nothing came of it, no money being available.

Mention may be made of one other effort in the same direction. The Veterans Administration, well aware of its increasing responsibilities as millions of vet-

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erans grow older, established an Advisory Committee on the Aging. At its second meeting this Committee decided to focus its attention on aging of the heart and blood vessels—a decision which was well taken.

LIFE EXPECTANCY

In the Statistical Bulletin of the Metropolitan Life Insurance Company for July 1957, there is a report on the changes in life expectancy which have taken place between 1900 and 1955 among whites in this country:

Life Expectancy of Males

	1900	1955	Increase of
At Birth	48.2	67.3	19.1 years
At 65	11.5	12.9	1.4 years

Life Expectancy of Females

	1900	1955	Increase of
At birth	51.1	73.6	22.1 years
At 65	12.8	15.5	2.7 years

The point I would emphasize above all is that, whereas the life expectancy of babies born in 1955 was very much greater than that of babies born in 1900, the life expectancy of adults who were 65 years of age in 1955 was only slightly greater than that of adults who attained this age in 1900. The figures are not available, but it is likely that the life expectancy of 65-year-olds today is about the same as it was in 1955, *i.e.*, the increase is almost negligible.

This can only mean that the causes of death among the 65-year-olds are almost as effective today as they were over fifty years ago, whereas the causes of death among younger people have been much reduced.

Greenberg (1) has described similar data of expectancy after age 67 for males. Men at this age in the United States can expect to last only a few months more. "The men of seven other countries do better than that—Dutchmen, Israelis, Norwegians, Swedes, New Zealanders, Danes and Britons, in that order. At birth a boy in Holland can look forward to outliving the average American boy by more than three years." We ask ourselves, why is the life expectancy less for males than for females, and less for American males than for those of males of several other nationalities? We don't know; but let us here consider only the decrease for both sexes at age 65.

The principal factors increasing life expectancy have been the discovery and mass utilization of means whereby acute infections and dietary deficiencies, which can be death-dealing in young people, are to a large extent prevented or cured. However, with older people but little progress has been made in the prevention and treatment of diseases that kill them, and in the correction of social maladjustments (which can be almost as bad as disease).

We hope that we shall be able to increase life expectancy at 65 years—that is to increase the average number of years a person of that age may be expected to go on living. "The 'life span,' properly conceived, is the limit beyond which human life does not extend even in the most favorable circumstances." This,

according to Louis I. Dublin (2), is placed at 100 years and has not changed appreciably within historical times. We want a few more years in average length of life and much more activity and usefulness during these years. The chief obstacles to be overcome are cardiovascular diseases and cancers.

CARDIOVASCULAR DISEASES AND CANCER

According to the Statistical Bulletin of the Metropolitan Life Insurance Company for February 1957: "Arteriosclerotic heart disease, including coronary disease, far outranks every other cause of death in the United States, accounting for more than 400,000 deaths a year, or far more than a fourth of the total mortality." Encouraging progress is being made in study of the closely related condition of atherosclerosis. It has been possible in animal experiments to remove fatty deposits in the walls of arteries by feeding unsaturated fats and most of the reading public knows about the great advances made in cardiac surgery. I am optimistic that in this area, life expectancy will be significantly increased.

It is stated in a later (July) issue of the same Bulletin, concerning cancer in later life, that:

"In 1956, there were more than 126,000 cancer deaths in the United States among persons of ages 65 and over. Outranked as a cause of death only by heart disease and cerebral hemorrhage, cancer accounted for nearly 15 per cent of the total mortality in this age group." . . . "It is also estimated that one in every four people reaching age 65 will eventually develop cancer. At the older ages the incidence of the disease is about one third higher for men than for women." The mortality is increasing for white men and decreasing for white women.

Looking to the future, we can never expect to be able to prevent all cancers, for the evident reason that we cannot go on living and completely avoid dangerous exposure to all of the agents capable of producing cancer. These are in the air we breathe, in the sunlight which shines on us, in what we eat, in what touches our skins—they are even produced by us in the secretions of some of our own glands. They make up in all, say, 4 or 5 hundred different chemical and physical influences. Nevertheless, we can reduce exposure to agents which affect large numbers of people and can be measured, like radioactivity and cigarette smoke. By lowering exposure to less hazardous levels, a significant number of cancers can be prevented.

Many early cancers are now cured; but advanced cancers, when they have spread throughout the body, are seemingly as death-dealing as ever. In attempting to cure them by chemical means we may not always remain helpless. I can think of two circumstances which are mildly reassuring. The first is that cancers, for no apparent reason, frequently exhibit alterations in rate of growth and, in extremely rare instances, stop growing altogether and disappear. Evidently influences capable of controlling certain cancers sometimes operate in our bodies. It may be a long time before we learn how to identify and to harness these naturally existing anti-cancerous influences, for our good.

The second favorable circumstance is that malignant cells of many different cancers, 1) by loss of the destructive properties of their cells of origin, and 2) by

assumption of common properties with the acquisition of malignancy, come to resemble each other quite closely. It is therefore anticipated that if an effective chemotherapeutic substance can be found, it may act not simply against one cancer but against all advanced cancers, since they are so much alike. If so, it may not be necessary to find a different agent for the treatment of each cancer.

Thus, confining our attention to the medical and biologic aspects of aging, we have grounds to hope that the ravages of the 2 principal plagues of people 65 years and older will be reduced within the forseeable future.

BIOLOGIC FACTORS

To explore these and other areas of research on aging to best advantage, the attitude of the physician is important. He must be alert, be free from constricting preconceived notions, and approach the problems presented by his patient, as a student, modestly and eager to learn. The need for alertness and freedom from preconceived ideas may be illustrated by two kinds of situations.

Genetic influence

It is usual for the pediatrician and people generally to look in children for the expression of hereditary traits. The geriatrician, who also sees everyday evidence of age factors, realizes that genetic influences may lie dormant for half a century or more, only to come forward with little warning. Dr. C. Nash Herndon (3) has furnished a long list of such conditions in which susceptibility is of noticeably common occurrence in families—for instance, diabetes mellitus, pernicious anemia, paralysis agitans, and Huntington's chorea. In addition to these overt manifestations of genetic qualities, one would expect others of seemingly minor consequence which might modify functional mechanisms by either weakening or strengthening them. Being on the alert for such manifestations is "expectant" or "anticipatory" geriatrics.

Reversal of pathologic processes

It is usual, also, to think of the irresistible development of certain lesions, and to take the attitude that in view of the advanced age of the patient these cannot be checked and will progress. However, some pathologic processes are reversible in the aged as well as in young persons. Contemplation of a list of these generates optimism. Starr (4) mentions that in old women the hyalinized and occluded uterine vessels can be canalized and restored to function by estrogen administration; that the myocardium can be restored to normal function when the myxedematous patient is appropriately treated with thyroxine; and that recovery from retinopathy in hypertensive renal disease can occur during strict observance of an antihypertensive regimen based on a salt-free diet. William B. Kountz (5) has published illustrations showing that, in elderly women, the nasal mucous membrane which has undergone squamous metaplasia can be restored to its normal ciliated state by estrogen therapy. The removal of fatty deposits from the arterial walls of experimental animals by dietary administration of unsaturated fats has already been mentioned. Let us not be too ready to consider

pathologic processes in the aged as irreversible. It would be a healthy exercise to extend this list, in the light of conditions known to be productive of reversals.

ATTITUDE OF THE PHYSICIAN

In planning research in the field of aging it is desirable not only to be alert for the fruition of long-dormant hereditary susceptibilities and for the occasional reversal of pathologic processes but also to have a lively appreciation of differences which are to be expected in the clinical and social behavior of old people as compared with young adults.

I am just completing the editing of a book written by 21 contributors on the "Care of the Geriatric Patient." In every aspect of this care, whether it be medical, psychiatric, surgical or otherwise, there is an ever-increasing mass of information concerning special features of the aging body and mind. Without this knowledge, geriatric medical care is not optimal. In clinical, as well as in laboratory research, it is essential for investigators who passed through medical schools years ago in their youth to remember that training in geriatrics was not given then, and that they must compensate for the lack of it by keeping their minds open and being eager to learn.

One way to learn of new developments by which we can improve the rather grim lot of people in the downswing of life is to attend conferences such as this, which are being conducted with increasing frequency by Dr. Bortz and other leaders in the field of gerontology. These conferences will go a long way toward educating medical faculties in their responsibility for making way in already crowded curricula for the teaching of geriatrics.

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Abstracts of Current Literature

MEASUREMENT OF GASTROINTESTINAL BLEEDING USING RADIOACTIVE CHROMIUM.
Bannerman, R. M. *Brit. M. J.* **2:** 1032 (Nov. 2) 1957.

A simple method is described for the quantitative estimation of fecal blood loss, using radioactive chromium in tracer doses. It consists essentially of labeling circulating red blood cells with radioactive chromium and subsequently measuring and comparing the radioactivity of samples of venous blood and feces. The method is not capable of measuring amounts of blood of less than 3 cc. in an average stool, and the use of a larger dose of radioactive chromium to overcome this limitation is not justified. The results of the test in 3 persons are given in detail. These were a 72-year-old man with bleeding from a hiatus hernia, a 61-year-old man with chronic intestinal bleeding for which no cause could be found, and a 38-year-old woman with bleeding from a duodenal ulcer. The test provided evidence not only of the quantity of blood lost daily but also of whether the site of bleeding was low or high in the gastro-intestinal tract. The results of the test correlated well with those of a commonly used qualitative benzidine occult blood test, discrepancies occurring when the amount of blood as indicated by one test or the other was small.

THE EFFECT OF THE ADMINISTRATION OF SEX HORMONES ON SERUM LIPIDS AND LIPOPROTEINS IN WOMEN. I. OESTROGENS.
Berezin, D., and von Studnitz, W. *Acta endocrinol.* **25:** 427 (Aug.) 1957.

A study was conducted to determine the effect of estrogen upon the electrophoretic lipid pattern and the serum lipid content in women of different ages with no evidence of vascular disease. Three females with primary amenorrhea and 4 with long-standing secondary amenorrhea received ethinyl estradiol in a daily dosage of 0.05 mg. Five postmenopausal women received 0.3 to 0.5 mg. diethylstilbestrol daily for climacteric symptoms for a six-week period. The total fat content of the serum increased in 9 women. The most consistent change was an increase in the alpha lipoproteins, both in terms of concentration in milligrams per 100 cc. of serum (which occurred in all cases) and as a percentage of the serum fat (which occurred in all but 1 case). This effect was observed independently of age and initial value. The serum cholesterol level increased in 6 of the 7 amenorrheal women and decreased in 4 of the 5 postmenopausal women. The change appeared to depend somewhat upon the level present at the beginning of treatment: When the initial value was high, estrogen usually produced a decrease; but otherwise, usually an increase. However, age itself might have caused a variation in the reaction in amenorrheal and postmenopausal women. The level of serum phospholipids increased in 9 women. In the 3 exceptions in which there was a decrease, the initial value was relatively high. The cholesterol-phospholipid ratio decreased in 4 cases, remained unchanged in 4, and increased slightly in 4.

THE EFFECT OF THE ADMINISTRATION OF SEX HORMONES ON SERUM LIPIDS AND LIPOPROTIENS IN WOMEN. II. ANDROGENS.
Berezin, D., and Von Studnitz, W. *Acta endocrinol.* **25:** 435 (Aug.) 1957.

The effect of androgen therapy upon the electrophoretic lipid pattern and the serum lipid content in women of varying age and without signs of vascular disease was investigated. The patients were as follows: 7 postmenopausal women, 5 surgical castrates, 4 females who had not yet reached the menopause, and 3 women with cancer of the collum or corpus of the uterus. The androgens administered were methylandrostenediol buccally in a dosage

of 25 to 100 mg. daily, methyltestosterone buccally in a daily dosage of 10 mg., and testosterone propionate intramuscularly, 25 mg. every other day for a total dose of 125 mg. Two courses of testosterone propionate were given seventeen days apart. The administration of androgen decreased the total fat content of the serum in postmenopausal women and, with 2 exceptions, in women at a reproductive age and in those with cancer. The level increased upon withdrawal of androgen and decreased again when treatment was resumed. Androgens usually brought about a decrease in alpha lipoprotein expressed both as a percentage of the total serum fat and as concentration in milligrams per 100 cc. The concentration increased in 5 of 8 women when androgen therapy was discontinued. The decrease in alpha lipoprotein level was due to a decrease in the total fat content, as well as to a reduction of the alpha lipoprotein fraction of the total fat in the serum. The serum cholesterol content decreased during treatment with androgen in 12 women, remained unchanged in 4, and increased in 3. The effect of androgen on the total fat, alpha lipoproteins, and cholesterol was reflected by the low initial values present in those patients who had received androgen therapy before the start of the experiment. The level of serum phospholipids decreased during treatment in 13 cases. The changes were usually in the same direction as those in the total fat and cholesterol content, and resulted in a lowering of the cholesterol-phospholipid ratio in 8 cases, an increase in 7, and no change in 4.

PREDNISONE IN TREATMENT OF CARDIAC DECOMPENSATION. A NEW TREATMENT OF CARDIAC PLEURAL EFFUSION.

Bolotin, M. T. *Am. Pract. & Digest Treat.* **8:** 1772 (Nov.) 1957.

Signs of myocardial failure developed in a 75-year-old man following an acute posterior myocardial infarction. He responded moderately well to treatment for myocardial failure but his condition later commenced to deteriorate and right pleural effusion was found. The patient failed to respond adequately to Thiomerin. Thoracentesis was performed several times and increasingly large amounts of chest fluid removed. The amount of fluid decreased dramatically within two weeks after the administration of 5 mg. of prednisone three times daily was begun. The right chest became free of fluid after twenty-eight days and the patient felt well. He has continued to do well for nine months and is receiving digitalis, Thiomerin twice weekly, vitamins, a salt-free diet, potassium chloride, and prednisone in a dosage of 5 mg. twice daily. Theories concerning the beneficial action of prednisone are cited, such as the possibility of direct action upon the myocardium, extracardiac benefits contributing to improved cardiac function, and increased diuresis.

AGING OF ARTERIES IN RELATION TO HYPERTENSION.

Conway, J., and Smith, K. S. *Circulation* **15:** 827 (June) 1957.

A clinical method has been devised for the qualitative assessment of the elastic properties of the arterial reservoir. The method depends upon changes in pulse pressure that occur after the inhalation of amyl nitrite as the blood pressure falls without change in heart rate. The test has been applied to 16 normal young subjects and 52 patients with hypertension. In the normal subjects little change in pulse pressure accompanied the fall in diastolic pressure after amyl nitrite—15 per cent of the fall in diastolic pressure. In the hypertensive group there were 15 patients with systolic or arteriosclerotic hypertension. In these patients the reduction in pulse pressure after amyl nitrite was 116 per cent of the simultaneous fall in diastolic pressure. The remaining patients with hypertension were grouped according to their responses to the elasticity test. In 20 patients the response was within the normal limits, and the average fall in pulse pressure was 28 per cent of the fall in diastolic pressure; these patients were believed to have normally elastic arteries. In 17 patients the fall in pulse pressure was 96 per cent of the fall in diastolic pressure and it did not differ significantly from the response of the arteriosclerotic patients; they were therefore believed to have inelastic arteries. Clinical differences between the elastic and

inelastic groups strongly suggested that these patients were in fact suffering from different diseases. The patients of the elastic group were younger and had a higher initial diastolic blood pressure than the patients of the inelastic group. (From authors' summary.)

A COMPARATIVE RADIOLOGICAL STUDY OF CALCIFIED ATHEROMA IN MALES AND FEMALES OVER 50 YEARS OF AGE.

Elkeles, A. *Lancet* **2:** 714 (Oct. 12) 1957.

Radiography of the abdominal aorta is a valuable method of detecting advanced atherosclerosis during life. This method was used to compare the incidence and the severity of calcified atheroma in 680 males and 572 females aged more than 50. The incidence and the severity of calcified atheroma are much less in females than in males before the age of 60, but in the later decades of life the sex ratio is reversed, and women show a much higher percentage of severe calcified atheroma than do men. The results of this investigation do not support the widely held view of a close relation between severe atherosclerosis and coronary artery disease insofar as this can be estimated from calcification in the abdominal aorta. The theory is advanced that spinal osteoporosis occurring after the decrease or cessation of sex hormone production is connected with the deposition of calcium in the aorta, and that spinal osteoporosis, which is far more common in women than in men, explains the high percentage of severe calcified atheroma in females after the menopause. An attempt was made to correlate the cancer-atherosclerosis theory with the results of the above investigation and with reports on the sex susceptibility to cancer at different ages. It has been found that, in women up to the age of 60, the incidence of atherosclerosis is much less than in men. In the later age groups when females show a significantly higher incidence of calcified atheroma than do men, cancer is much more common in males than in females. The results of this investigation in conjunction with the observations on sex susceptibility to cancer are further evidence that people with severe calcified atheroma are relatively immune to cancer. (From author's summary)

ACUTE INFECTIOUS MONONUCLEOSIS IN A 64 YEAR OLD WOMAN.

Fitz-Hugh, T., Jr. *Blood* **12:** 398 (Apr.) 1957.

In the differential diagnosis of chronic lymphatic leukemia, acute infectious mononucleosis must be considered as a possibility. This disease is thought to be rare after the age of 35 years, but a case is presented which occurred in an elderly spinster and which resembled lymphatic leukemia. This obese, hypertensive patient had slight icterus and enlarged lymph nodes in the neck and axillae. Diagnoses other than leukemia were investigated because the normal erythrocyte and platelet levels, the predominantly adult type of lymphocytosis, and the absence of ulceration and hemorrhage indicated that the cause was not leukemia. Subsequently the results of the heterophil antibody test were found to be positive. Other studies showed evidence of liver damage, a single renal cyst, hepatosplenomegaly, and an electrocardiographic pattern of myocardial damage with left ventricular hypertrophy. Irradiation therapy, begun when the patient was thought to be suffering from acute leukemia, was discontinued. The patient improved under conservative management. The heterophil antibody titer remained positive (1:56) two months after diagnosis and the cephalin flocculation test yielded a plus 1 result. Hematologically the patient became normal. This case could not be accounted for on the basis of the oral interchange of saliva.

ESOPHAGEAL RUPTURE ASSOCIATED WITH PEPTIC ULCER.

Hewlett, T. H., and Buchanan, A. C. *Am. Pract. & Digest Treat.* **8:** 1733 (Nov.) 1957.

Conservative management is not justified in the case of esophageal rupture. Operation performed soon after the rupture offers far greater possibilities that the patient will survive.

Even a long interval between the time of perforation and the time of operation does not contraindicate surgery. The perforation is best closed by way of the pleural cavity. Debris must be cleared and drainage of the mediastinum arranged by means of thoracotomy tubes. The 2 cases of esophageal rupture presented illustrate, respectively, faulty and successful management. In each instance, peptic ulcer was a factor leading to rupture of the esophagus. A mistaken diagnosis of perforated peptic ulcer was made in the first patient. Upon exposure of the esophagus, a rent on its postero-lateral surface was missed. An aggressive surgical approach in the second patient, with transpleural closure of the esophagus twenty-four hours following rupture, was successful. This patient subsequently underwent partial gastrectomy for the relief of pyloric obstruction due to peptic ulcer. The symptoms of, the clinical findings in, and the roentgenologic findings in rupture of the esophagus are enumerated. Recognition of the possibility of rupture of the esophagus will increase the accuracy of diagnosis and provide an opportunity for surgical management and a greater salvage rate among patients so affected.

MEGABLASTIC ANEMIA AND VITAMIN B_{12} DEFICIENCY AFTER ANTICONVULSANT THERAPY. REPORT OF TWO CASES.

Kidd, P., and Mollin, D. L. *Brit. M. J.* **2:** 974 (Oct. 26) 1957.

Case histories are given for 2 patients with epilepsy in whom megaloblastic anemia developed during treatment with phenytoin sodium and phenytoin sodium plus primidone, respectively. The cause of the megaloblastic anemia was uncertain. Each patient had evidence of vitamin B_{12} deficiency due to dietary inadequacy. Although the serum concentration of this vitamin was extremely low, neither patient had Addisonian pernicious anemia. This deficiency may have helped to precipitate the anemia. One of the patients had evidence of deranged folic-acid metabolism and, in her, the anemia failed to respond to the administration of vitamin B_{12} alone. When folic acid was given in addition, the anemia responded completely, even though treatment with phenytoin sodium was continued. It has been suggested that megaloblastic anemia occurring in patients receiving anticonvulsant drugs may be due to interference with the metabolism of folic acid in the tissues.

TREATMENT OF RAGWEED HAY FEVER WITH POWDERED HYDROCORTISONE APPLIED INTRANASALLY.

Lake, C. F.; Logan, G. B., and Peters, G. A. *Proc. Staff Meet., Mayo Clin.* **32:** 641 (Oct. 30) 1957.

Eighteen patients with ragweed hay fever whose symptoms had been difficult to control by conventional methods were treated by the intranasal application of powdered hydrocortisone. Of the 3 children, 2 received 5 mg. daily, and 1 received 7.5 mg. daily. The 15 adults received 15 mg. daily in three or four inhalations from a powder dispenser. The results were evaluated at the end of one month. Six patients obtained marked relief of symptoms. In 8, the condition was sufficiently improved that there were only minimal residual symptoms. Three obtained approximately 50 per cent relief of symptoms, and 1 patient was not benefited. Improvement began within three to five days and became noticeable at a time when the pollen count was high. One patient with a fair result required supplemental therapy with Copyronil. One with a good result required prednisolone for four days early in his treatment. Thereafter this patient and 1 other with a good result received supplemental therapy with an antihistaminic drug. One patient noted local irritation, but it could not be determined whether this was due to the powder or to an exacerbation of hay fever. No symptoms of hypercortisonism occurred, nor any infection in the nose during the intranasal use of hydrocortisone. It is concluded that this is an effective means of therapy for the patient in whom hay fever is not controlled by conventional means.

SLIDING HIATUS HERNIA—A REVIEW OF CASES.

MacDougall, J. T., and Abbott, A. C. *Canad. M. A. J.* **77:** 752 (Oct. 15) 1957.

Sliding hiatus hernia is not a rare condition and its occurrence may explain symptoms in patients once thought to have a psychoneurosis, hyperchlorhydria, duodenal ulcer without roentgenographic evidence, gastritis, or functional dyspepsia. Of 108 patients seen during a five-year period, 24 were judged suitable for, or requiring operation. The majority of the 108 patients were 60 to 80 years of age. However, hiatus hernia does not occur solely in middle-aged or elderly persons. The patients in the operative series gave a history of reflux esophagitis. These symptoms had not been relieved by medical treatment. Many of them had associated diseases. The diagnosis was made in the nonsurgical patients and in 18 of the surgical group by barium series. Esophagoscopy was required before it could be established in 6 patients. Severe cardiovascular disease, severe cerebral lesions, and neoplastic disease were considered to contraindicate operation. Among the 24 who underwent the operation described by Allison, the results were good in 18 and fair in 5 patients. The procedure relieved reflux esophagitis and these persons could eat without difficulty. Postoperative complications included atelectasis in 5 patients, pulmonary sepsis in 1, chest pain in 1, and wound infection in 2. Acute pancreatitis recurred in 1 patient who had had a similar experience following a previous operation. Follow-up has now been possible for one to five years (1 patient followed five years). There has been no evidence of recurrence in any patient. One patient died of unknown causes two years postoperatively. Allison's operation is concluded to be satisfactory in relieving symptoms due to reflux esophagitis. Suture of the peritoneal reflection and phreno-esophageal fascia to the under surface of the diaphragm, with narrowing of the hiatus from behind, appears to give security against recurrence.

THE LONG TERM REGULATION OF DICUMAROL DOSAGE BY THE VENOUS CLOTTING TIME.

MacRae, L. D., and MacRae, D. E. *Am. Pract. & Digest Treat.* **8:** 1740 (Nov.) 1957.

This second study on the control of Dicumarol dosage by the venous clotting time comprised 149 patients treated for a composite of approximately 3,000 weeks. The dosage plan begins with low doses in order to test the patient's tolerance. Regulation of the dosage grows easier as the physician becomes familiar with the technic of the test, with the patient, and with factors that alter the clotting time. It has been possible to extend the use of Dicumarol to 1) patients with clotting times averaging five minutes or over before administration of the drug, 2) patients with cerebrovascular accidents with venous clotting times no longer than seven minutes, 3) patients with symptoms once thought to be on an arteriosclerotic basis, such as vagueness, loss of memory, carelessness in appearance, lack of activity, and lack of interest in the environment, 4) patients with menorrhagia and hematuria not due to carcinoma, and 5) patients with a history of bleeding from an ulcer. Patients who once require Dicumarol are likely to continue to need it. Elderly patients especially are safer if the drug is continued. Factors that alter the venous clotting time were studied. Clotting time may be shortened by stressful situations, hospitalization, special diets, the performance of many laboratory tests, or the administration of amphetamine, Metrazol or digitalis. It is likely to be lengthened if the patient is in a state of cardiac decompensation or receives barbiturates, aspirin, cortisone or intravenous fluids. Each patient reacts in his own pattern to changes in environment and this causes corresponding variations in clotting time. Venous clotting times were compared with prothrombin times for the control of Dicumarol dosage. Experience showed that patients were safer when the so-called 2-3-5 clotting tests were used than when the prothrombin time was determined. Several case histories illustrate the adaptability of the clotting-time procedure and the difficulties encountered when relying upon prothrombin tests. When a patient has received Dicumarol

for four years or more, it is advisable to lengthen the clotting time. The need for this becomes especially apparent when the patient is under stress. With venous clotting-time control, the danger of major hemorrhage appears to be less than that reported with other methods. Excessive dosage, if administered in gradually increasing amounts, can be detected by the 2-3-5 clotting time and by gradual bleeding which usually occurs from the kidneys. No hemorrhage was experienced with venous clotting times under twelve minutes during the course of this study.

ATHEROSCLEROSIS AND THE FAT CONTENT OF THE DIET.

Page, I. H.; Stare, F. J.; Corcoran, A. C.; Pollack, H., and Wilkinson, C. F., Jr. *Circulation* **16:** 163 (Aug.) 1957.

Atherosclerosis, cerebral thrombosis, and myocardial infarction are diseases in which numerous factors are involved. Diet and nutrition are important factors in experimental atherosclerosis and, very probably, in the human disease. Thrombosis and infarction of the cerebral, cardiac, and renal vessels occur in severely sclerosed arteries, but so far neither has been clearly produced experimentally. Evidence is presented to suggest a possible general association with high fat consumption, but it is difficult to disentangle this from caloric balance, exercise, changes in body weight, and other metabolic and dietary factors that may be involved. Thus, the evidence at present does not convey any specific implications for drastic dietary changes, specifically in the quantity or type of fat in the diet of the general population, on the premise that such changes will definitely lessen the incidence of coronary or cerebral artery disease. On the other hand, the fact that obesity is a nutritional failure, that it is caused by consuming more energy than one expends and that dietary fats are the most concentrated source of energy (providing some 40 to 45 per cent of the daily caloric intake) suggests that many should consume less calories. For most, this will mean eating less fat. Prudence, as well as habit and taste, will dictate the selection of a diet with some fat. Diets providing 25 to 30 per cent of the calories from fat, rather than the current 40 to 45 per cent in the American diet, can still provide palatable meals for our accustomed tastes. The key points of nutritional common sense for better health generally, and most likely in regard to atherosclerosis specifically, consist of a balanced, varied diet that adjusts total calories so that a desirable weight is reached or maintained. Such a diet should provide more protein from lean meat, fish, poultry, and animal products, cereal and grain products, and a reasonable selection of fruits and vegetables. The fat content should be sufficient only to meet caloric and essential fatty-acid demands. These conclusions obviously apply to the general population, and not to persons with a strong family history of early deaths from cardiovascular disease, who are being observed with some regularity by their physician. Here, the newer concepts of nutrition readily suggest various types of diet therapy that may prove useful to certain patients. Investigative procedures of this type, together with continued basic research, will, in time, provide the facts upon which sound dietary recommendations may be made to the public at large and which may help in lessening the prevalence of cerebral and coronary disease with consequent stroke and myocardial infarction. (From authors' conclusions.)

OVARIAN FUNCTION AFTER THE MENOPAUSE.

Randall, C. L.; Birtch, P. K., and Harkins, J. L. *Am. J. Obst. & Gynec.* **74:** 719 (Oct.) 1957.

The cervical smears of 1,867 women at varying lengths of time after (I) spontaneous cessation of menstruation (1,473), (II) hysterectomy with preservation of the ovaries (183), and (III) castration (112) were examined for cytologic evidence of estrogen effect. No woman had menstruated for more than a year previously and had not been receiving estrogen. Estrogen effect persisted in 55.2 per cent of the women in Group I. The percentage with estrogen deficiency grew as the number of years after the cessation of menses increased,

except that among women whose smears were evaluated more than fifteen years after the menopause the percentage showing an estrogen-deficiency effect was lower than among women whose smears were evaluated between ten and fifteen years after the menopause. When the smears of Groups I and II were compared, 21 per cent fewer women in Group II showed evidence of estrogen deficiency after five to ten years than in Group I patients after the same interval. When Groups II and III were compared, evidence of ovarian deficiency was found in 30 per cent fewer women in the former group. This result is the basis for a recommendation that the ovaries be preserved when hysterectomy is performed, as it appears that they may continue to function for years thereafter. Since in this study castration resulted in a deficiency of estrogen effect in 40 per cent of women within five years, and in over 50 per cent of women after ten years, removal of the ovaries would appear to contribute to the eventual disability of more women than seem destined to suffer from malignancy of the ovary. The proportion of women whose smears indicated the persistence of estrogen effect for years after the removal of both ovaries suggests that tissues other than the ovary may furnish a source of estrogen. However, there is little to indicate that, once the ovaries have been removed, estrogen from these sources will be provided in amounts to meet the deficiency due to removal of the ovaries. The data in this study also suggest that the incidence of hypertension among women having smears of the estrogen-deficiency type two years after the menopause is greater than the average incidence of vascular disease at this age. The reverse is true when estrogen effect persists, in that the incidence of mild hypertension appears to be only one-third to one-fourth of the average expected figure.

THE URINARY EXCRETION OF DEHYDROEPIANDROSTERONE AND TOTAL 17-KETOSTEROIDS IN AGED MEN AND WOMEN.

Schraer, H.; Schraer, R.; Hartsfield, M., and Gershon-Cohen, J. *J. Gerontol.* **12:** 391 (Oct.) 1957.

Urinary excretions of dehydroepiandrosterone and total 17-ketosteroids were determined in young and aged subjects, and were found to fall with aging. The 24-hour excretion of dehydroepiandrosterone fell from 3.4 ± 1.8 mg. in young adult men (20 to 35 years) to 0.5 ± 0.3 mg. in aged men (64 to 90 years); and from 4.0 ± 1.5 mg. in young adult women (18 to 40 years) (data of Bray and Merivale) to 0.4 ± 0.1 mg. in aged women (64 to 91 years). Results of this study indicated that the percentage of 17-ketosteroids excreted as dehydroepiandrosterone declines with age in both men and women. It has been suggested that the fall in anabolic hormones in both the adrenal gland and the gonads is more rapid than the decline of catabolic hormones of adrenal origin. (From authors' summary.)

CLINICAL OBSERVATIONS ON THE USE OF HYDROXYZINE IN ANXIETY-TENSION STATES AND SENILE AGITATION.

Settel, E. *Am. Pract. & Digest Treat.* **8:** 1584 (Oct.) 1957.

Hydroxyzine (Atarax) was used for its tranquilizing properties in 83 patients—(I) 33 with anxiety and tension states, (II) 30 with anxiety neuroses, and (III) 20 with mild senile agitation. Group I comprised adults and a few children who carried out their daily tasks but were nervous, excitable and spasmophilic. The patients with anxiety neuroses were adults not sufficiently disturbed to require hospitalization. The senile patients under care in a nursing home were in an agitated state—disobedient and hostile. The dosage of hydroxyzine ranged from 10 to 25 mg. two or three times daily. The drug was administered for periods of two to thirty weeks. A good or excellent response was obtained in 30, 18, and 15 patients, in Groups I, II and III, respectively. The drug was judged to be the most valuable in tension and anxiety states and in mild senile agitation. Tension decreased markedly. The patients could relax and became better able to control their tempers. They functioned more efficiently and could take an objective interest in their problems. Senile patients became more quiet and easier to manage. Their personal hygiene and sleeping habits im-

proved. In 20 patients among the 83, no appreciable benefit was noted after trial of the drug for two to four weeks. Mild, transient drowsiness occurred as a side-effect in 6 patients. An outstanding advantage of hydroxyzine was its ability to supress exaggerated responses to external or internal stimuli without dulling the patient's perspective or sense of values.

ANABOLIC THERAPY IN THE AGED.

Sobel, I. J. *M. Times* **85:** 1095 (Oct.) 1957.

Sixty-five patients, 35 of whom were 50 to 90 years of age, had been treated with Vistabolic for periods of two to four weeks at the time of evaluation of this method of therapy. Hypertension, coronary artery disease, menopausal symptoms, and anxiety neurosis were the conditions most frequently present. Other conditions included secondary anemia, rheumatoid arthritis, male climacteric, diabetes mellitus, and obesity. Some patients were affected by multiple diseases. Vistabolic contains in each tablet 1 mg. of hydrocortisone for its effect in adrenal hypofunction and stressful states, 10 mg. of methylandrostenediol for its protein anabolic action, and 0.5 U.S.P. oral unit of vitamin B_{12} for its effect in nutritional deficiency, together with intrinsic factor concentrate to ensure absorption of the vitamin. The injectable form contains hydrocortisone, methylandrostenediol and 20 micrograms of vitamin B_{12}. After attempting to alleviate any organic causes for the patients' symptoms, each received 1 cc. of Vistabolic solution by injection daily for two days and then 2 tablets of this preparation daily supplemented by an injection of 1 cc. at weekly intervals. In addition, simple psychotherapeutic measures were used and the patients given an adequate diet with particular attention to the protein content. This treatment brought about the rapid reversal of neurasthenia, feeling of insecurity, fatigue, and lack of energy in 85 per cent of the patients. The use of Vistabolic is recommended in geriatric patients whose symptoms indicate that they need better nutrition and would profit from the administration of small amounts of adrenal and anabolic hormones.

STUDIES ON ALDOSTERONE SECRETION IN MAN.

Thorn, G. W.; Ross, E. J.; Crabbe, J., and Van't Hoff, W. *Brit. M. J.* **2:** 955 (Oct. 26) 1957.

The mean level of aldosterone excretion in normal adult subjects was found to be 5.0 μg. per twenty-four hours (S.D. ± 3.0) with an unrestricted diet. No correlation was found between the excretions of aldosterone and of sodium at levels of aldosterone excretion below 8 μg. per twenty-four hours, but a correlation existed above that level. The mean value for urinary aldosterone excretion during the day was three times that at night. Factors that influence the excretion of aldosterone are considered: 1) The effect on aldosterone excretion of corticotropin given intravenously over an eight-hour period on two successive days was irregular and there was no correspondence between the response of aldosterone and that of 17-hydroxycorticoids. 2) In a patient with diabetes insipidus receiving Pitressin, 100 mEq. of sodium daily, and unrestricted fluids, urinary aldosterone excretion increased from 7 to 12 μg. per twenty-four hours after withdrawal of Pitressin, an effect thought to have been mediated by the deficit of body water under these circumstances. 3) Increased aldosterone excretion follows sodium restriction but most normal subjects show a fall in urinary sodium before this takes place, so that other factors are operating in the response of the kidneys to a lowered intake of sodium. 4) A moderate, short-term increase in the potassium intake of normal subjects does not affect aldosterone excretion appreciably. 5) Aldosterone disappears from the urine during the administration of amphenone. Studies with this substance suggest that it may be useful to evaluate the significance of increased aldosterone levels in patients with evidence of excessive sodium retention, as in nephrosis, cirrhosis and congestive heart failure. A case is reported of secondary hyperaldosteronism that existed in a patient with prolonged generalized edema who had been subjected to efforts to relieve the edema by reduction of salt intake and vigorous diuretic therapy. An

adenoma was found in the left adrenal, and this organ was removed. That aldosterone was secreted only by the adenoma was suggested by the fact that its removal resulted in a prompt sodium diuresis and the disappearance of aldosterone from the urine. Aldosterone was found in the tumor but not in the surrounding tissue. Later the right adrenal gland became the site of increased aldosterone production and the syndrome recurred with intractable edema. An immediate and profound diuresis occurred after removal of the right adrenal gland and subsequently aldosterone disappeared from the urine. No hypertension, hypokaliemia, hypochloremia, or alkalosis occurred in this patient. The manifestations of primary hyperaldosteronism are contrasted with those of the syndrome of "potassium depletion" seen in medicine and surgery. It is noted especially that patients with hyperaldosteronism have large quantities of potassium in the urine and hypokaliemia, whereas persons with potassium depletion due to other causes have low urinary potassium levels and an acid urine. Secondary hyperaldosteronism can be differentiated from the primary form by the tendency of these patients to have edema, a low urinary concentration of sodium, and lack of evidence of severe potassium depletion.

THE GENETIC ASPECTS OF ATHEROSCLEROSIS.

Wheeler, E. O. *Am. J. Med.* **23:** 653 (Oct.) 1957.

Several diseases which appear to be (in part at least) genetically determined, predispose persons to the development of atherosclerosis. These include diabetes, hypertension, idiopathic hyperlipemia, and familial hypercholesterolemic xanthomatosis. Except for the last, the methods of inheritance of these disorders has not been settled. Familial hypercholesterolemic xanthomatosis is associated with a high prevalence of coronary heart disease, presumably as a result of a basic abnormality in lipid metabolism. It is inherited by simply Mendelian dominance. Hypercholesterolemia is present from early life, whereas the appearance of xanthoma and coronary heart disease is dependent upon time and the severity of the lipid abnormalities. (From author's conclusions.)